HANDBOOK

OF

CHEMISTRY AND PHYSICS

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CHEMISTRY AND PHYSICS

A READY-REFERENCE POCKET BOOK
OF CHEMICAL AND PHYSICAL DATA

PRICE, TWO DOLLARS

COMPILED FROM THE MOST
RECENT AUTHORITATIVE SOURCES
AND PUBLISHED BY

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PREFACE TO CRC HANDBOOK OF CHEMISTRY AND PHYSICS FACSIMILE FIRST EDITION

To mark the appearance of the 85th Edition of the *CRC Handbook of Chemistry and Physics*, the publisher has produced this facsimile of the First Edition, which came out in 1913. Comparison of the first and eighty-fifth editions illustrates the progress of science over the intervening years. Publication of the First Edition coincided with the appearance of Niels Bohr's revolutionary paper on the hydrogen atom, and came only eight years after Einstein's "miraculous year" when he published his historic papers on relativity, Brownian motion, and the photoelectric effect. Only 81 elements were known in 1913, the electron had been discovered only 17 years before, and the proton and neutron were still unknown. Madame Curie had just won her second Nobel Prize, and Max Planck, Niels Bohr, and Albert Einstein had yet to be recognized with this honor.

The evolution of the *CRC Handbook of Chemistry and Physics* has paralleled the growth of modern science and the technological revolution that resulted. Since this first volume in 1913, the *Handbook* has been revised annually except for a few wartime years. It has grown steadily in both size and diversity of information. The 13th Edition in 1928 contained 1214 pages plus a few advertisements for rubber aprons and stoppers. Nine pages were devoted to atomic

spectra (compared to over 150 much more densely packed pages today). The charge of the electron was given to four figures (now ten figures). The 29th Edition in 1945 had reached 2640 pages, with no advertising, but was still in the smaller 4.5×7 inch page format. It included data on amino acids and artificial radioisotopes, and the charge of the electron was quoted to six figures. Post World War II editions expanded in step with the growth of the general scientific establishment, soon leading to the present large-page format. In the last three decades information has been added on lasers, the genetic code, global climate change, high temperature superconductors, and other topics that were unknown when many of us started our scientific education.

Throughout its history the *CRC Handbook* has emphasized three goals: accuracy, currency, and convenience. Data are taken whenever possible from evaluated sources and subjected to stringent quality control. The annual cycle for new editions permits new, improved data to be incorporated quickly and coverage of emerging scientific areas to be added. While the book passed the coat-pocket size long ago, we have retained the single volume format that finds its way to thousands of desks and laboratory benches. Development of an electronic version was started five years ago, and the full content, accompanied by powerful search and retrieval software, is now available on the Internet and as a CDROM product. As the needs of users change, new features and new delivery mechanisms will continue to be introduced.

We hope this reprint of the first edition will prove interesting to current *Handbook* users and that it will illustrate the enormous advances in scientific knowledge over the last century.

David R. Lide
Editor-in-Chief

PREFACE

In compliance with the requests of hundreds of our friends for a small but comprehensive book of reference on chemical and physical topics, we have designed and compiled this Pocket Manual of Chemistry and Physics.

We shall feel amply rewarded for our effort and expense if this volume proves to be of use and convenience to the profession whose support has been a conspicuous factor in the growth of our establishment.

The material here included has been carefully selected by W. R. Veazey, Ph. D., Chemistry Department, Case School of Applied Science. The compiler has been guided in his selections by the suggestions of more than a thousand members of high standing in the Chemical and Physical profession.

We desire to express our appreciation and thanks to the many persons who have co-operated with us in the preparation of this book.

THE CHEMICAL RUBBER COMPANY

Cleveland, Ohio

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HANDBOOK OF CHEMISTRY AND PHYSICS

INTERNATIONAL ATOMIC WEIGHTS 1911

Aluminum	Al	27.10
Antimony	Sb	120.20
Argon	A	39.88
Arsenic	As	74.96
Barium	Ba	137.37
Bismuth	Bi	208.00
Boron	B	11.00
Bromine	Br	79.92
Cadmium	Cd	112.40
Caesium	Cs	132.81
Calcium	Ca	40.09
Carbon	C	12.00
Cerium	Ce	140.25
Chlorine	Cl	35.46
Chromium	Cr	52.00
Cobalt	Co	58.97
Columbium	Cb	93.50
Copper	Cu	63.57
Dysprosium	Dy	162.50
Erbium	Er	167.40
Europium	Eu	152.00
Fluorine	F	19.00
Gadolinium	Gd	157.30
Gallium	Ga	69.90
Germanium	Ge	72.50
Glucinum	Gl	9.10
Gold	Au	197.2
Helium	He	3.99
Hydrogen	H	1.008
Indium	In	114.80
Iodine	I	126.92
Iridium	Ir	193.10
Iron	Fe	55.85
Krypton	Kr	82.90
Lanthanum	La	139.00
Lead	Pb	207.10
Lithium	Li	6.94
Lutecium	Lu	174.00
Magnesium	Mg	24.32
Manganese	Mn	54.93
Mercury	Hg	200.00
Molybdenum	Mo	96.00
Neodymium	Nd	144.30
Neon	Ne	20.20
Nickel	Ni	56.68
Nitrogen	N	14.01
Osmium	Os	190.90
Oxygen	O	16.00
Palladium	Pd	106.70
Phosphorus	P	31.04
Platinum	Pt	195.20
Potassium	K	39.10
Praseodymium	Pr	140.60
Radium	Ra	226.40
Rhodium	Rh	102.90
Rubidium	Rb	85.45
Ruthenium	Ru	101.70
Samarium	Sa	150.40
Scandium	Sc	44.10
Selenium	Se	79.20
Silicon	Si	28.30
Silver	Ag	107.88
Sodium	Na	23.00
Strontium	Sr	87.63
Sulphur	S	32.07
Tantalum	Ta	181.00
Tellurium	Te	127.50
Terbium	Tb	159.20
Thallium	Tl	204.00
Thorium	Th	232.00
Thulium	Tm	168.50
Tin	Sn	119.00
Titanium	Ti	48.10
Tungsten	W	184.00
Uranium	U	238.50
Vanadium	V	51.06
Xenon	Xe	130.20
Ytterbium	Yb	172.00
Yttrium	Y	89.00
Zinc	Zn	65.37
Zirconium	Zr	90.06

ANTIDOTES OF POISONS

1. *Acetic Acid.*—Emetics, magnesia, chalk, soap, oil.

2. *Carbolic Acid.*—Any soluble nontoxic sulphate, after provoking vomiting with zinc sulphate; uncooked white of egg in abundance, milk of lime, saccharate of calcium, olive or castor oil with magnesia in suspension, ice, washing the stomach with equal parts water and vinegar; give alcohol or whisky or about 4 fluid ounces camphorated oil at one dose.

3. *Hydrochloric Acid.*—Magnesia, alkali carbonates, albumen, ice.

4. *Hydrocyanic Acid.*—Hydrogen peroxide internal, and artificial respiration, breathing ammonia or chlorine from chlorinated lime, ferrous sulphate followed by potassium carbonate, emetics, warmth.

5. *Nitric Acid.*—Same as for hydrochloric.

6. *Phosphoric Acid.*—Same as for hydrochloric.

7. *Sulphuric Acid.*—Same as for hydrochloric with the addition of soap or oil.

8. *Sulphurous Acid or Sulphur Dioxide.*—Mustard plaster on chest; narcotics, expectorants.

9. *Iodine.*—Emetics, stomach siphon, starchy foods in abundance, sodium thiosulphate.

10. *Lead Acetate.*—Emetics, stomach siphon, sodium, potassium or magnesium sulphates, milk, albumen.

11. *Mercuric Chloride or Corrosive Sublimate.*—Zinc sulphate, emetics, stomach siphon, white of egg, milk, chalk, castor oil, table salt, reduced iron.

12. *Sodium Hydroxide or Potassium Hydroxide.*—Vinegar, lemon juice, orange juice, oil, milk.

VAPOR TENSION OF WATER IN MILLIMETERS OF MERCURY – 2° TO + 36°C.

According to Regnault, Broch, and Weibe

°C.	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
–2	3.958	3.929	3.900	3.872	3.844	3.815	3.787	3.760	3.732	3.705
–1	4.258	4.227	4.197	4.166	4.136	4.106	4.076	4.046	4.016	3.987
–0	4.579	4.546	4.513	4.481	4.448	4.416	4.384	4.352	4.321	4.289
0	4.579	4.612	4.646	4.679	4.713	4.747	4.782	4 816	4.851	4.886
1	4.921	4.957	4.992	5.028	5.064	5.101	5.137	5.174	5.211	5.248
2	5.286	5.324	5.362	5.400	5.438	5.477	5.516	5.555	5.595	5.635
3	5.675	5.715	5.755	5.796	5.837	5.878	5.920	5.961	6.003	6.046
4	6.088	6.131	6.174	6.217	6.261	6.305	6.349	6.393	6.438	6.483
5	6.528	6.574	6.620	6.666	6.712	6.759	6.806	6.853	6.901	6.949
6	6.997	7.045	7.094	7.143	7.192	7.242	7.292	7.342	7.392	7.443
7	7.494	7.546	7.598	7.650	7.702	7.755	7.808	7.861	7.914	7.968
8	8.023	8.077	8.132	8.187	8.243	8.299	8.355	8.412	8.469	8.526
9	8.584	8.642	8.700	8.759	8.818	8.877	8.937	8.997	9.057	9.118
10	9.179	9.240	9.302	9.364	9.427	9.490	9.553	9.616	9.680	9.745
11	9.810	9.875	9.940	10.006	10.072	10.139	10.206	10.274	10.342	10.410
12	10.479	10.548	10.617	10.687	10.757	10.828	10.899	10.970	11.042	11.114
13	11.187	11.260	11.333	11.407	11.481	11.556	11.631	11.706	11.782	11.859
14	11.936	12.013	12.091	12.169	12.247	12.326	12.406	12.486	12.566	12.647
15	12.728	12.810	12.892	12.974	13.057	13.141	13.225	13.309	13.394	13.480
16	13.565	13.651	13.738	13.825	13.913	14.001	14.090	14.179	14.269	14.359
17	14.450	14.541	14.632	14.724	14.817	14.910	15.003	15.097	15.192	15.287
18	15.383	15.479	15.575	15.672	15.770	15.868	15.967	16.066	16.166	16.266
19	16.367	16.469	16.571	16.673	16.776	16.880	16.984	17.088	17.193	17.299
20	17.406	17.513	17.620	17.728	17.837	17.947	18.057	18.167	18.278	18.390
21	18.503	18.616	18.729	18.844	18.959	19.074	19.190	19.307	19.424	19.542
22	19.661	19.780	19.900	20.021	20.142	20.264	20.386	20.510	20.634	20.758
23	20.883	21.010	21.137	21.264	21.393	21.522	21.652	21.782	21.913	22.045
24	22.178	22.311	22.446	22.581	22.716	22.853	22.990	23.128	23.266	23.406
25	23.546	23.686	23.828	23.970	24.113	24.257	24.401	24.547	24.693	24.839
26	24.987	25.135	25.284	25.434	25.584	25.736	25.888	26.041	26.195	26.349
27	26.505	26.661	26.818	26.976	27.134	27.294	27.454	27.615	27.777	27.939
28	28.103	28.267	28.432	28.599	28.766	28.933	29.102	29.271	29.442	29.613
29	29.785	29.958	30.132	30.307	30.482	30.659	30.836	31.015	31.194	31.374
30	31.555	31.737	31.919	32.103	32.288	32.473	32.660	32.847	33.036	33.225
31	33.416	33.607	33.799	33.992	34.187	34.382	34.578	34.775	34.973	35.172
32	35.372	35.573	35.775	35.978	36.182	36.387	36.593	36.800	37.008	37.217
33	37.427	37.638	37.851	38.064	38.278	38.493	38.710	38.927	39.146	39.365
34	39.586	39.807	40.030	40.254	40.479	40.705	40.933	41.161	41.390	41.621
35	41.583	42.085	42.319	42.554	42.791	43.028	43.266	43.506	43.747	43.989

VAPOR TENSION OF WATER IN MILLIMETERS OF MERCURY + 30° TO + 230°C.

According to Regnault, Broch, and Weibe

°C.	0	1	2	3	4	5	6	7	8	9
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
30	31.56	33.42	35.37	37.43	39.59	41.85	44.23	46.73	49.35	52.09
40	54.97	57.98	61.13	64.43	67.89	71.50	75.28	79.23	83.36	87.67
50	92.17	96.87	101.77	106.88	112.21	117.77	123.56	129.59	135.87	142.41
60	149.21	156.29	163.65	171.30	179.25	187.51	196.09	204.99	214.24	223.84
70	233.79	244.11	254.84	265.91	277.41	289.32	301.65	314.42	327.64	341.32
80	355.47	370.11	385.25	400.90	417.08	433.79	451.07	468.91	487.33	506.36
90	526.00	546.27	567.19	588.77	611.04	634.01	657.69	682.11	707.29	733.24
100	760.00	787.57	816.0	845.3	875.4	906.4	938.3	971.1	1004.9	1039.6
110	1075 4	1112.1	1149.8	1188.6	1228.4	1269.4	1311.5	1354.7	1399.0	1444.5
120	1491	1539	1588	1639	1691	1744	1798	1854	1911	1970
130	2030	2092	2155	2220	2286	2354	2423	2494	2567	2641
140	2718	2795	2875	2957	3040	3125	3213	3302	3393	3486
150	3581	3678	3778	3879	3983	4088	4196	4307	4419	4534
160	4651	4771	4893	5018	5145	5274	5406	5541	5678	5819
170	5961	6107	6255	6406	6560	6717	6877	7040	7205	7374
180	7546	7721	7899	8080	8265	8453	8644	8838	9036	9237
190	9442	9650	9862	10078	10299	10519	10745	10975	11208	11447
200	11688	11934	12183	12436	12694	12955	13220	13490	13764	14042
210	14324	14611	14901	15197	15496	15800	16109	16422	16740	17062
220	17389	17721	18058	18399	18745	19096	19452	19813	20179	20549
230	20925									

COMPOSITION OF SOME TYPICAL ENGINEERING ALLOYS

	IRON	TIN	ANTIMONY	LEAD	COPPER	ZINC	BISMUTH	PHOS.
Bell metal		22.0			78.0			
Brass					72.0	28.0		
Brass (yellow)					60.0	40.0		
Bronze for bearings		16.0			82.0	2.0		
Speculum metal		33.4			66.6			
Muntz metal					60.0	40.0		
Mosaic gold					65.0	35.0		
Gun metal		91.0				9.0		
Bronze		94.0			1.0	5.0		
Babbitt metal		45.5	13.0	40.0	1.5			
Britannia metal		90.0	10.0					
Pewter		80.0		20.0				
Soft solder		50.0		50.0				
Tobin bronze	0.2	0.9		0.4	61.2	37.3		
Phosphor bronze		10.0	9.5		79.7			0.8
Rose metal		22.9		27.1			50.0	
Car-box metal	0.61		14.38	84.33		0.68		
"B" Alloy P. R. R.		8.0		15.0	77.0			trace
White metal		82.0	12.0		6.0			
Type metal		3.0	15.0	82.0				

FUSIBLE ALLOYS

MELTING POINT, °C.	PERCENTAGE COMPOSITION				OBSERVER OR SPECIAL NAME
	Lead	Tin	Bismuth	Cadmium	
55.5	25.00	12.50	50.00	12.50	
65.5	25.00	12.50	50.00	12.50	Wood
67.5	25.21	14.10	51.07	9.60	Wood von Hauer
68.5	24.24	13.65	49.09	13.09	v. Hauer
70.0	28.60	14.30	50.00	7.10	Wood
75.5	25.80	14.70	52.40	7.00	Wood
76.5	34.38	9.37	50.00	6.25	v. Hauer
77.0	29.41	17.65	47.06	5.88	
80.0	25.00	25.00	43.75	6.25	Harper
82.0	42.86		50.00	7.14	Wood
88.0	42.86		50.00	7.14	n. v. Hauer
89.5	39.52		53.36	7.11	v. Hauer
90.0	34.97	29.90	35.13		Rose
91.6	30.00	20.00	50.00		Onions Lichtenberg
93.0	25.00	25.00	50.00		Erman Rose
94.0	42.10	15.80	42.10		Rose
95.0		33.33	50.00	16.67	v. Hauer
95.0	58.33		33.33	8.34	
98.0	31.25	18.75	50.00		Newton, d'Arcet
99.0	33.34	33.33	33.33		
100.0	50.00	30.00	20.00		
105.0	26.67	44.76	23.81	4.76	v. Hauer
111.0	40.00	20.00	40.00		Bismuth solder
119.0	48.39	38.71	12.90		
124.0	38.84	22.14	39.02		
128.0	44.45	44.44	11.11		
130.0	38.46	30.77	30.77		
132.0	28.00	47.00		25.00	v. Hauer
136.0	26.47	59.32		14.30	v. Hauer
140.0		68.29	31.71		
145.0	50.00	30.00	20.00		
150.0	40.74	44.44	14.82		
155.0	42.86	42.86	14.28		Bismuth solder
160.0	53.57	32.14	14.29		
165.0		75.65		24.35	v. Hauer
171.0	33.33	66.67			Soft quick solder
175.0	89.77	10.23			Spring
180.0	37.00	63.00			Drop solder
185.0	46.73	53.27			
190.0	41.23	58.77			
194–195	84.00	16.00			
200.0	50.00	50.00			

LIST OF APPARATUS AND MATERIAL FOR EXPERIMENTS IN PHYSICS

Tools and Measurements

Micrometer Caliper.
Vernier Caliper (new design).
Meter Stick, brass tipped.
Wire Cutting Pliers, 5 inch.
Metric Diagonal Scale.
Wire Gauge.

Properties of Matter

Adhesion Disc.
Cohesion Plates.
Prince Rupert Drops.
Capillary Tubes and Support.
Osmose Apparatus.
Inertia Apparatus.
Elasticity of Flexure Apparatus.
Breaking Strength of Wire Apparatus.

Mechanics of Solids

Collision Balls with No. 694 Arc.
Composition of Forces.
Lever Holders (3).
Pulley, single, 2 hook.
Pulley, double, 2 hook.
Inclined Plane with Arc.
Hall's Carriage.
Center of Gravity Apparatus.
Second Law of Motion Apparatus.
Rotator (whirling table).
Centrifugal Hoop.
Two Balls on rod, for rotator.
Ring, Chain and Cylinder.
Gyroscope.
Three Spring Balances, Met. and Eng., flat back.

Mechanics of Fluids

Equilibrium Tubes.
Hall's Pressure Gauge.
Bottle Imp and Jar.
Hydraulic Press.
Boyle's Law Tube.
Siphon.
Tantalus Cup.
Archimedes Principle.
Lift Pump.
Force Pump.
Demonstration Hydrometer.
Hydrometer for heavy liquids.
Hydrometer Jar, 12x2½.
Barometer Tube, Cup and Pipette.

Pneumatics

Oil Sealed Air Pump.
Vacuum Wax.
Vacuum Gauge.
Bell in Vacuo.
Three Bursting Squares.
Freezing Apparatus.
Bell Glass, 1 gallon.
Hand and Bladder Glass.
Sheet Rubber, 1 square foot.
Mercury Shower.
Magdeburg Hemispheres.
Bacchus Illustration.
Spirometer (Seven-in-One).
Water Hammer.
Guinea and Feather Tube, Fountain in Vacuo and Aurora Tube combined.

Heat

Copper Boiler (Apparatus A).
Air Thermometer.
Chemical Thermometer.
Conductometer.
Ball and Ring.
Compound Bar.
Palm Glass.
Linear Expansion Apparatus.
Calorimeter.
Tyndall's Specific Heat Apparatus.
Fire Syringe.
Convection Apparatus.
Radiometer.
Sectional Model of Steam Engine.
Alcohol Lamp, 8 ounce.
(Bunsen Burner substituted if desired).
Tripod for same.

LIST OF APPARATUS AND MATERIAL FOR EXPERIMENTS IN PHYSICS—Continued

Magnetism

Lodestone.
Bar Magnet, 6 inch.
Horseshoe Magnet, 6 inch.
Iron Turnings.
Electro Magnet.
Magnetic Needle.
Compass, 40 mm.

Electricity

Friction Rod, wax.
Friction Rod, vulcanite.
Catskin.
Pith Balls, 1 dozen.
Pith Images, pair.
Electrical Pendulum.
Electroscope.
Toepler-Holtz Electric Machine with attachment and shocking handles.
Brass Chains with hook and snap.
Leyden Jar, quart.
Discharger.
Image Plates.
Hollow Globe.
Proof Plane.
Bell Chimes.
Universal Support.
Volta's Hail Storm.
Electric Flier.
Holder for Tubes, etc.
Geissler Tube, 8 inch.
Plunge Battery, 2 cell.
Demonstration Coil.
Electric Motor.
Decomposition of Water.
Galvanometer.
One Pound Magnet Wire for connections.

Sound

Savart's Wheel.
Siren Disc.
Tuning Fork.
Tuning Fork on Resonant case.
Sonometer.
Violincello Bow.
Organ Pipe.
Chladni Plates and Clamp.
Oscillograph.

Wave Motion

Crova's Disc.
Spiral of Brass Wire.

Light

Newton's Disc.
Concave and Convex Mirrors.
Multiple Image Apparatus.
Incidence and Reflection App.
Sextant.
Equilateral Prism, 4 inch.
Demonstration Lenses, 2 inch.
Lens, 10 cm. focus.
Lens, 15 cm. focus.
Index of Refraction.
Blocks for supporting Meter Stick.
Lens Support.
Screen Support.
Screen.
Pin Support.
Iceland Spar, medium.
Newton's Rings.

LIST OF APPARATUS AND MATERIAL FOR EXPERIMENTS IN CHEMISTRY

Beakers, nest of 5 (3 to 20 oz.).
Blow Pipe, plain, 8 inch.
Bottles, W. M., two 8 oz.
Bottles, N. M., two 8 oz.
Burette, 25 cc. 1-10ths.
Corks, 2 dozen, assorted.
Cork Borers, set 1-3.
Cork Screw, wood handle.
Crucibles, Hessian, 2 nests large 5s.

LIST OF APPARATUS AND MATERIAL FOR EXPERIMENTS IN CHEMISTRY—Continued

Crucible Tongs, 9 in.
Deflagrating Spoon, brass, ½ inch.
Dish, Crystallizing, 4 inch.
Dish, Evaporating, 2 oz.
Dish, Evaporating, 6 oz.
Dish, Lead, 3 inch.
File, Triangular, 5 inch.
File, round, 5 inch.
Filter Paper, 1 pkg., 5 inch.
Flasks, F. B., two 4 oz.
Flask, F. B., 8 oz.
Flask, F. B., 16 oz.
Funnel, glass, 2½ inch.
Funnel, glass, 4 inch.
Gas Bag, with stopcock, 1 gal.
Gas Generating Flask, quart.
Glass Tubing, 1 lb., 3-16-½.
Graduate, conical, 100 cc.
Hand Balance, 5 inch beam, with weights.
Hydrometer, for heavy liquids.
Jar for Hydrometer, 12x2½.
Jar, Specie, for deflagration, two 1 quart size.
Lamp, Alcohol, 4 oz.
Mortar, Wedgewood, 3¾ inch.
Pipette, Volumetric, 5 cc.
Pipette, Volumetric, 10 cc.
Pneumatic Trough, student's.
Reagent Bottles, 1 set of 24.
Retort, glass, plain, 16 oz.
Receiver for Retort, 8 oz.
Reduction Tube for reducing metallic oxides.
Retort Stand, 3 ring.
Rubber Tubing, 6 feet, ¼ inch.
Sand Bath, 4 inch.
Spatula, steel, 4 inch.
Stirring Rods, 3, 5x3-16.
Test Glass, 2 oz.
Test Tubes, 2 dozen, assorted.
Test Tubes, 1 dozen, 6x¾.
Test Tube Brush, sponge end.
Test Tube Holder, wire.
Test Tube Support, 13 tubes with drying pins.
Thermometer, Paper Scale, 110°C.
Thistle Tubes, Two.
U Tube, 6 inch.
Watch Glass, 2½ inch.
Watch Springs, for burning in oxygen, ½ dozen.
Wire Gauze, 4x4.
Woulff Bottle, 3 neck, pint.

½ lb. Acetic Acid.
1 lb. Hydrochloric Acid.
1 lb. Nitric Acid.
1 oz. Oxalic Acid.
2 lbs. Sulphuric Acid.
1 oz. Tartaric Acid.
1 oz. Ammonium Carbonate.
2 oz. Ammonium Chloride.
½ lb. Ammonium Hydrate.
1 oz. Ammonium Nitrate.
1 oz. Ammonium Sulphide.
½ pt. Alcohol Methyl.
2 oz. Alum.
2 oz. Animal Charcoal.
1 oz. Antimony.
1 oz. Arsenic Trioxide.
1 oz. Barium Chloride.
1 oz. Barium Nitrate.
1 oz. Borax.
¼ lb. Calcium Carbonate (marble).
2 oz. Calcium Chloride.
2 oz. Calcium Fluoride.
¼ lb. Calcium Sulphate.
1 oz. Carbon Bisulphide.
1 oz. Cobalt Nitrate.
4 oz. Copper Sulphate.
2 oz. Ether.
2 oz. Ferrous Sulphate.
8 oz. Ferrous Sulphide.
½ oz. Gall Nuts (powdered).
⅛ oz. Gun Cotton.
¼ oz. Iodine.
2 oz. Galena.
1 oz. Lead Acetate.
4 oz. Lead Oxide (red).
4 oz. Lead Monoxide.
½ oz. Litmus (best cubes).
12 in. Magnesium Ribbon.
4 oz. Magnesium Sulphate.
1 lb. Manganese Dioxide (powdered).

LIST OF APPARATUS AND MATERIAL FOR EXPERIMENTS IN CHEMISTRY—Continued

4 oz. Mercury.
½ oz. Mercuric Chloride.
½ oz. Mercuric Oxide.
12 in. Platinum Wire.
½ oz. Phosphorus.
⅛ oz. Potassium (metallic).
½ lb. Potassium Bichromate.
1 oz. Potassium Bromide.
2 oz. Potassium Carbonate.
½ lb. Potassium Chlorate.
1 oz. Potassium Chromate.
½ oz. Potassium Cyanide.
2 oz. Potassium Ferricyanide
2 oz. Potassium Ferrocyanide
1 oz. Potassium Hydrate (sticks).
¼ oz. Potassium Iodide.
2 oz. Potassium Nitrate.
½ oz. Potassium Permanganate.
1 oz. Potassium Sulphate.
⅛ oz. Silver Nitrate.
¼ oz. Sodium (metallic).
1 oz. Sodium Acetate.
4 oz. Sodium Carbonate.
2 oz. Sodium Hydrate (sticks)
2 oz. Sodium Hyposulphite.
2 oz. Sodium Sulphate.
1 oz. Sodium Phosphate.
1 oz. Strontium Nitrate.
½ lb. Sulphur Roll.
½ lb. Zinc for making Hydrogen.

CORRECTIONS OF BAROMETER READINGS FOR TEMPERATURE

Glass Scale (Bunsen) mm. to be Deducted

BAROMETER READING	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
mm.										
700	0.120	0.240	0.359	0.479	0.599	0.719	0.838	0.958	1.078	1.198
705	0.121	0.241	0.362	0.483	0.603	0.724	0.844	0.965	1.086	1.206
710	0.121	0.243	0.364	0.486	0.607	0.729	0.850	0.972	1.093	1.215
715	0.122	0.245	0.367	0.489	0.612	0.734	0.856	0.979	1.101	1.223
720	0.123	0.246	0.370	0.493	0.616	0.739	0.862	0.986	1.109	1.232
725	0.124	0.248	0.372	0.496	0.620	0.744	0.868	0.992	1.116	1.240
730	0.125	0.250	0.375	0.500	0.625	0.749	0.874	0.999	1.124	1.249
735	0.126	0.252	0.377	0.503	0.629	0.755	0.880	1.006	1.132	1.258
740	0.127	0.253	0.380	0.506	0.633	0.760	0.886	1.013	1.140	1.266
745	0.127	0.255	0.382	0.510	0.637	0.765	0.892	1.020	1.147	1.275
750	0.128	0.257	0.385	0.513	0.642	0.770	0.898	0.027	1.155	1.283
755	0.129	0.258	0.388	0.517	0.646	0.775	0.904	1.033	1.163	1.292
760	0.130	0.260	0.390	0.520	0.650	0.780	0.910	1.040	1.170	0.300
765	0.131	0.262	0 393	0.524	0.654	0 785	0.916	1.047	1.178	1.309
770	0 132	0.264	0.395	0.527	0.659	0.790	0.922	0.054	1 186	1.317
775	0 133	0.265	0 398	0.530	0.663	0.796	0.928	1.061	1.193	1.326
780	0.133	0.267	0.400	0 534	0.667	0.801	0 934	1.068	1.201	1.335
785	0.134	0.269	0.403	0.537	0.672	0 806	0.940	1.075	1.209	1.343
790	0.135	0 270	0.406	0 541	0 676	0.811	0 946	1.081	1.217	1.352
795	0.136	0 272	0 407	0.544	0.680	0.816	0 952	1.088	1.224	1.360
800	0.137	0 274	0.411	0.548	0.684	0 821	0.958	1 095	1.232	1.369

FUNDAMENTAL CHEMICAL LAWS

Scientific laws are statements of facts which have been established by direct experiment.

Boyle's Law for Gases.—At a constant temperature the volume of a given quantity of any gas varies inversely as the pressure to which the gas is subjected. This idea is expressed in the following formulae:

$$PV = \text{a constant, or } P_1 = 1/V, \text{ or } V = 1/P, \text{ or } PV = P_1V_1$$

The Law of Combining Weights.—If the weights of elements which combine with each other be called their "combining weights," then elements always combine either in the ratio of their combining weights or of simple multiples of these weights.

Law of Definite Proportions.—In every sample of each compound substance the proportions by weight of the constituent elements are always the same.

Dalton's Law of Partial Pressures.—The pressure exerted by a mixture of gases is equal to the sum of the separate pressures which each gas would exert if it alone occupied the whole volume. This fact is expressed in the following formula:

$$PV = V\ (p_1 + p_2 + p_3, \text{ etc.})$$

Faraday's Law.—The amounts of decomposition effected by the passage of equal quantities of electricity through them are, for the same electrolyte equal, and for different electrolytes are proportional to the combining weights of the elements or radicles which are deposited.

Gay Lussac's Law for Gases (or Charles' Law).—At a constant pressure, the volume of a given quantity of any gas, increases about 1/273 of its volume at 0°C. for each rise of 1°C. and at constant volume the pressure of a given quantity of any gas increases about 1/273 of the pressure at 0°C. for each rise of 1°C. in temperature.

Gay Lussac's Law of Combining Volumes.—If gases interact and form a gaseous product, the volumes of the reacting gases and the volumes of the gaseous products are to each other in very simple proportions, which can be expressed by small whole numbers.

Hess's Law of Constant Heat Summation.—The amount of heat generated by a chemical reaction is the same whether reaction takes place in one step or in several steps, or all chemical reactions which start with the same original substances, and end with the same final substances, liberate the same amounts of heat, irrespective of the process by which the final state is reached.

Henry's Law.—The amount of gas which a liquid will dissolve is directly proportional to the pressure of the gas. This holds for all gases which do not unite chemically with the solvent.

The Law of Mass Action.—At a constant temperature the product of the active masses on one side of a chemical equation when divided by the product of the active masses on the other side of the chemical equation is a constant, regardless of the amounts of each substance present at the beginning of the action.

Law of Multiple Proportions.—Two elements may combine in more than one proportion by weight but if so, the weights of one

element which combine with a fixed weight of the other element, are always in a simple ratio to each other.

The Periodic Law.—The physical and chemical properties of the elements are functions of their atomic weights and most of these properties are periodic functions of the atomic weights.

FUNDAMENTAL CHEMICAL THEORIES

A scientific hypothesis is an endeavor to form a rational mental picture of the causes which lead to a group of observed facts even though these causes may not be subject to direct proof.

A scientific theory is an hypothesis whose consequences have been so thoroughly tested by experiment, that it has become generally accepted as the correct explanation for a group of facts.

The Atomic Theory.—All elementary forms of matter are composed of very small unit quantities called atoms. The atoms of a given element all have the same size and weight. The atoms of different elements have different size and weight. Atoms of the same or different elements unite with each other to form very small unit quantities of compound substances called molecules.

Avogadro's Theory.—Equal volumes of all gases under the same conditions of temperature and pressure contain equal numbers of molecules.

The Electrolytic Dissociation or Ionization Theory.—When an acid, base or salt, is dissolved in water or any other dissociating solvent, a part or all of the molecules of the dissolved substance are broken up into parts called ions, some of which are charged with positive electricity and are called cations, and an equivalent number of which are charged with negative electricity and are called anions.

Electrolytic Solution Tension Theory (or the Helmholtz Double Layer Theory).—When a metal, or any other substance capable of existing in solution as ion is placed in water or any other dissociating solvent, a part of the metal or other substance passes into solution in the form of ions, thus leaving the remainder of the metal or substance charged with an equivalent amount of electricity of opposite sign from that carried by the ions. This establishes a difference in potential between the metal and the solvent in which it is immersed.

The Electron Theory.—An atom of any element consists of a definite number of unit negative charges of electricity moving in orbits inside the atom with velocities which approach the velocity of light.

DEFINITION OF CHEMICAL AND PHYSICAL TERMS

Absolute zero is that temperature at which a gas would show no pressure (or no volume) if it obeyed Gay Lussac's law for gases under all conditions (i.e., 273°C.).

An acid is any substance which yields hydrogen ions.

An adiabatic expansion is an expansion of a gas which occurs in such a way that heat is neither given off nor absorbed during the process.

The active mass of a substance is the number of gram-molecular-weights per liter in solution, or in gaseous form.

Adsorption. The ability of a solid to condense gases, liquids, or dissolved substances on their surfaces is called adsorption. It is a manifestation of the force of adhesion.

An atom is the smallest unit quantity of an element that is capable of entering into chemical combination.

An ampere is a rate of flow of electricity equal to one coulomb per second.

A base is any substance which yields hydroxyl ions.

A balanced or reversible action is one which can be caused to proceed in either direction by suitable variation in the conditions of temperature, volume, pressure or of the quantities of reacting substances.

A British Thermal Unit or B.T.U. is the quantity of heat required to raise the temperature of 1 pound of water 1° F. 1 Large Calorie equals 3.9683 B.T.U.

The small calorie is the amount of heat required to raise 1 gram of water from 15° C. to 16° C. Symbol cal.

The Large Calorie is equal to 1000 small calories. Symbol Cal.

The Average Calorie is the amount of heat required to raise 1 gram of water from 0° C. to 100° C. under a pressure of 760 mm. It is equal to nearly 100 calories. Symbol K.

A Catalytic Agent is a substance which by its mere presence alters the velocity of a reaction, and may be recovered unaltered in nature or amount at the end of the reaction.

A Colligative property is a property which is numerically the same for a group of substances, independent of their chemical nature.

A Constitutive Property is a property which depends on the constitution or structure of the molecule.

A Cryohydrate is the solid which separates when a saturated solution freezes. It contains the solvent and the solute in the same proportions as they were in the saturated solution.

A Coulomb is that quantity of electricity which will deposit 1.118 milligrams of silver from a solution of a silver salt.

A Combining weight of an element or radicle is its atomic weight divided by its valence.

A Eutectic is that alloy of two or more metals which has the lowest melting point.

The Hydrogen Equivalent of a substance is the number of replaceable hydrogen atoms in 1 molecule or the number of atoms of hydrogen with which 1 molecule could react.

The Heat of Combustion of a substance is the amount of heat evolved by combuation of 1 gram of the substance.

An Ion is a charged atom or group of atoms in solution. Solutions always contain equivalent numbers of positive and negative ions.

A Kilowatt is equivalent to 1000 watt-hours.

A Molecule is the smallest unit quantity of matter which can exist by itself and retain all the properties of the original substance.

A Molar Solution contains 1 gram molecular weight of dissolved substance per liter of solution.

A Normal Solution contains 1 gram molecular weight of dissolved substance divided by the hydrogen equivalent of the substance, per liter of solution.

An Ohm is a resistance equal to that of a column of mercury 106.3 cm. long and 1 sq. cm. cross section at 0°C.

Oxidation is any process which increases the proportion of oxygen or acid forming element or radicle in a compound.

Reduction is any process which increases the proportion of hydrogen or base forming elements or radicle in a compound.

A Salt is any substance which yields ions, other than hydrogen or hydroxyl ions.

The Solubility Product or precipitation value is the product of the concentrations of the ions of a substance in a saturated solution of the substance.

A Volt is the intensity or electromotive force which will cause a flow of 1 ampere through a resistance of 1 ohm.

A Watt is the power to do the work, which is possessed by a current of 1 ampere with an intensity of 1 volt.

A Watt-Hour is the work equivalent to a current of 1 ampere at 1 volt, flowing for 1 hour.

CRITICAL TEMPERATURE AND PRESSURE AND OTHER CONSTANTS OF GASES

Freezing Point, Boiling Point (76 cm.), and Critical Data, Van der Waal's Constants (for 1 gr.)

	FREEZING PT.	LAT. HT. OF FUS.	BOIL. PT.	LAT. HT. OF VAP. AT BOIL. PT.	DENS. AT BOIL. PT.	CRIT. TEMP.	CRIT. PRES. (ATM.)	CRIT. DENS.	a	b
Hydrogen	−260.0	16.0	−252.5	200.0	0.070	−240.8	13.4–15		5160	9.28
Oxygen	−227.0 (9 mm.)		−181.5	52.0	1.135	−118.0	50.0	0.65	1320	0.98
Nitrogen	−210.0 (94 mm.)		−194.0	48.0	0.790	−145.0	34.0	0.37	1700	1.40
Air			−191.0			−142.0	37.8			
Argon	−188.0		−186.0		1.212	−117.0	52.0		810	0.77
Helium			−268.8			−268.0	2–3.0	0.15		
Sulphur dioxide			−10.0	82.0	1.460	155.0	78.9	0.55	1610	0.87
Chlorine	−102.0		−33.6	67.0		146.0	93.5			
Ammonia	−75.0	108.0	−38.5	295.0		131.0	113.0		13800	2.11
Nitrogen peroxide			22.5	93.0		171.2				
Carbon dioxide			−78.2			31.0	77.0	0.29	1857	0.971
Ethylene			−103.0			10.0	38.0	0.22		
Acetylene						36.5	61.6	0.31	5930	1.80
Water	0.0	80.0	100.0	537.0		364.0	195.0	0.43	18000	1.84
Acetic acid	17.0	43.7	118.0	85.0		321.0	57.0	0.351	4884	1.78
Ethyl alcohol			78.3	201.5		240.0	64.0	0.228	5700	1.834
Benzol	5.4	30.2	80.2	93.0		288.0				
Acetone			56.4	125.3		238.0	52.0			
Carbon bisulphide			46.0	83.8		277.0	78.0	0.354		
Ether			38.0	90.0		190.0	37.0	0.246	3180	1.82
Chloroform			60.1	59.0		260.0	55.0			

COMPARISON OF WIRE GAUGES

Brown & Sharp's Gauge No.							8	9	10	11	12	13	14	15	16	17	18	19
Nearest Stubb's Gauge No.							10	11	12	13	14	15	16	17	18	19	19	20
Nearest Music Gauge No.									34	33	30	28	26	25	23	20	18	16
Fractional Part of an Inch.							$\frac{1}{8}$	$\frac{7}{64}$		$\frac{3}{32}$	$\frac{5}{64}$		$\frac{1}{16}$			$\frac{9}{64}$		
Brown & Sharp No.	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	34	35	36
Stubbs No.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	34	35	35	
Music No.	14	12	10	9	8	7	6	5	3	2	1	0	00					
Inch.	$\frac{1}{32}$						$\frac{1}{64}$											

CONVERSION OF THERMOMETER DEGREES

Degrees C $\times$ 1.8 + 32 = Degrees F.

Degrees $\frac{F - 32}{1.8}$ = Degrees C.

Degrees $\frac{R \times 9}{4} + 32$ = Degrees F.

Degrees $\frac{(F - 32)\,4}{9}$ = Degrees R.

Degrees $\frac{R \times 5}{4}$ = Degrees C.

Degrees $\frac{C \times 4}{5}$ = Degrees R.

PHYSICAL CONSTANTS OF THE ELEMENTS

NAME	DERIVATION	SYMBOL	ATOMIC WEIGHT O 16	SPECIFIC GRAVITY WATER 1 AIR 1 (A) HYDROGEN 1 (D)	SPECIFIC HEAT AT °C.	VALENCE (PRINCIPAL)	ELECTRICAL CONDUCTIVITY AT °C.	THERMAL CONDUCTIVITY K AT °C. Ag 1.00
1. Aluminum	L. alumen, alum	Al	27.1	2.583 at 4° C.	.2220	3	324000	.3435
2. Antimony (stibium)	LL. antimonium	Sb	120.2	6.62	.0495	3 or 5	27100	.0442
3. Argon, gas		A	39.88	1.379 A				.000038
4. Arsenic, Amorph.	L. arsenicum	As	74.96	19.96 D 4.716 at 14° C.	.1233 .0758	0 3 or 5	28600	
5. Barium	Gr. barys, heavy	Ba	137.37	3.75		2		
6. Bismuth	G. (unknown origin)	Bi	208.0	9.7474	.3013	3	9260	.0177
7. Boron	borax	B	11.0	2.45	.3066	3		
8. Bromine, Gas	Gr. bromos stench	Br	79.92	5.8691 at 60° A	.0555	1		
9. Liquid				3.1883 at 0°	.1071			
10. Cadmium	Gr. kadmeia, calamine	Cd	112.4	8.642 at 17° C.	.0548	2	146000	.2213
11. Caesium	L. caesius, sky blue	Cs	132.81	.87 at 20° C.	.04817	1	25400	
12. Calcium	L. calx, lime	Ca	40.09	1.145	.1453	2	95000	
13. Carbon 14. Amorph.	L. carbo, charcoal	C	12.0	1.75–2.10	.241	4 or 2		
15. Graphite				2.10–2.58	.202			
16. Diamond				3.47–3.558	.1469			
17. Cerium	Planet Ceres	Ce	140.25	7.0424	.04479	4		
18. Chlorine, Gas	Gr. chloros, green	Cl	35.46	2.491 at 0° A	.1241	1		
19. Chromium	Gr. chroma, color	Cr	52.0	6.92 at 20° C.	.1039	3 or 6		
20. Cobalt	G. kobold, goblin	Co	58.97	8.718	.1030	2 or 3	83200	
21. Columbium	Columbia (niobium)	Cb	93.5	7.06		3 or 5		
22. Copper	Cyprus	Cu	63.57	8.91–8.96	.0936	1 or 2	640600	.7198
23. Dysprosium		Dy	162.5					
24. Erbium	Ytterby, a town in Sweden	Er	167.4	4.77		2 or 6		
25. Fluorine, Gas	L. fluor, flow	F	19.0	1.31 A at 15°		1		

PHYSICAL CONSTANTS OF THE ELEMENTS

LINEAR COEFFICIENT OF EXPANSION	at °C.	MELTING POINT °C.	BOILING POINT °C.	DISCOVERED	BY WHOM	WHERE AND HOW FOUND
.00002313	40	657	2200	1828	Wohler	In many rocks (the most abundant metal).
.00001152	40	630	1600	1450	Valentine	Chiefly as sulphide and in various metallic ores.
.....		−187.9	−186.1	1894	Rayleigh and Ramsay	Rare element in the air.
.00000559	40	.....	360	1694	Schroder	Native, as sulphide and in various metallic ores.
.....		850	950	1808	Davy	In barite and witherite.
.00001346	40	269	1435	1450	Valentine	Native as sulphide and in rare minerals.
.....		infusible	vol. 3500	1808	Davy	In borax and various minerals.
.....		.....	.....	1828	Balard	Mainly in sea water and other natural brines.
.....		−7.3	58.7	....	.....	
.00003069	40	321.7	778	1817	Stromeyer	In small amount in zinc ores.
.0003948	27	26.37	670	1860	Bunsen	In lepidolite, pollucite and mineral springs.
.....		795	.....	1808	Davy	In limestone and abundantly other rocks.
.0000054	40	sublimes	3500	....	Prehistoric	In coal, limestone and all organic matter.
.00000786	40	sublimes	3500	....	.....	
.00000118	40	sublimes	3500	....	.....	
.....		623	.....	1803	Berzelius	In cerite and other rare minerals.
.....		−102	−33.6	1774	Scheele	In common salt (NaCl) and other chlorides.
.....		1515	.....	1797	Vauquelin	Mainly in chrome-iron ore.
.00001236	40	1464	.....	1773	Brandt	In many metallic ores.
.....		1950	.....	1801	Hatchett	In columbite and other rare minerals.
.00001678	40	1065	2100	....	Prehistoric	Native and in many ores.
.....		.....	.....	.....	.....	
.....		.....	.....	1843	Mosander	In rare minerals as gadolinite, etc.
.....		−223	−187	1771	Scheele	In fluorite (CaF_2) and other minerals.

PHYSICAL CONSTANTS OF THE ELEMENTS—Continued

NAME	DERIVATION	SYMBOL	ATOMIC WEIGHT O 16	SPECIFIC GRAVITY WATER 1 AIR 1 (A) HYDROGEN 1 (D)	SPECIFIC HEAT AT °C.	VALENCE (PRINCIPAL)	ELECTRICAL CONDUCTIVITY AT °C.	THERMAL CONDUCTIVITY K AT °C. As 1.00
26. Gadolinium	Gadolin, a Russian chemist....	Gd	157.3	1.31	.....	3	.....	.....
27. Gallium....	L. Gallia, France.....	Ga	69.9	5.95 at 24	.079	3	.....	.....
28. Germanium	L. Germania Germany..	Ge	72.5	5.469 at 20	.0737	4	.....	.....
29. Glucinum (beryllium)	Gr. glykys, sweet	Gl	9.1	1.85 at 20	.....	2	.....	.....
30. Gold.....	Aurum Anglo-Saxon	Au	197.2	19.32	.0136	3	468000	.7003
31. Helium, Gas	.....	He	3.99	0.1368 A	.....	0	.....	.00033
32. Hydrogen, Gas.....	Gr. water-forming....	H	1.008	0.06949 A	3.41	1	.....	.00032
33. Indium.....	From its Indigo Spectrum	In	114.8	7.12	.0569	3	119500	.....
34. Iodine, solid	Gr. Iodes violet.....	I	126.92	4.948 at 17	.0541	1	.....	.....
35. Iridium, cryst....	L. iris, a rainbow.....	Ir	193.1	22.42	.0323	3	.....	.....
36. Iron, pure..	L. ferrum, Anglo-Saxon iron....	Fe	55.85	7.85	.1162	2 or 3	131000	.1665
37. Krypton, Gas.....	.....	Kr	82.9	2.818 A	.....	0	.....	.....
38. Lanthanum	Gr. lanthano conceal....	La	139.0	6.1545	.04485	3	.....	.....
39. Lead.....	L. plumbum	Pb	207.1	11.34	.0310	2	50400	.0836
40. Lithium....	Gr. lithos, stone.....	Li	6.94	0.534 at 20	.8366	1	119000	.....
41. Magnesium.	Magnesia, district in Thessaly..	Mg	24.32	1.72	.2456	2	230000	.376
42. Manganese.	L. magnes, magnet....	Mn	54.93	7.42	.1217	2 or 4 or 6	.....	.....
43. Mercury....	Hydrargyrum.....	Hg	200.0	13.5953	.03346	1 or 2	10630	.0148

PHYSICAL CONSTANTS OF THE ELEMENTS—Continued

	LINEAR COEFFICIENT OF EXPANSION	MELTING POINT °C.	BOILING POINT °C.	DISCOVERED	BY WHOM	WHERE AND HOW FOUND
	at °C.					
86	.....	.....	.....	1886	Marignac	In rare minerals as gadolinite, etc.
87	.....	30.15	.....	1875	Boisbaudran	In certain zinc blendes.
88	.....	900	vol. 1350	1886	Winkler	In argyrodite a rare mineral.
89	.....	960	.....	1828	Wohler	In beryl and several rare minerals.
90	.0000147	1060	2530	....	Prehistoric	Generally free, rarely combined in various ores.
91	.....	−270	−268.7	1895	Ramsay and Travers	Rare element in the air and in the sun.
92	.....	−256.5	−252.5	1766	Cavendish	Mainly in water and organic substances.
93	.0000417 40	115	red heat	1863	Reich and Richter	In certain zinc ores.
94	.0000837	113.7	185.5	1811	Courtois	Mainly in the ashes of seaweeds.
95	000007 40	1950	.....	1803	Tennant	In iridosmine.
96	.00001182	1505	.....	1895	Ramsay and Travers	As oxide and sulphide and in nearly all rocks.
97	.....	−169	−151.7	....	.....	Rare element in the air.
98	.....	810	.....	1839	Mosander	In cerite and other rare minerals.
99	.00002924	327	1580	....	Prehistoric	In galena (PbS) and other ores.
00	.....	180	1400	1817	Arfvedson	In lepidolite, spodumene, and some rare minerals.
01	.00002694	632.6	2200	1829	Bussy	In sea water magnesite and many rocks.
02	.....	1207	.....	1774	Gahn	In pyrolusite and many other minerals.
03	.000182	−38.85	357.33	....	Prehistoric	Native and in cinnabar (HgS).

PHYSICAL CONSTANTS OF THE ELEMENTS—Continued

NAME	DERIVATION	SYMBOL	ATOMIC WEIGHT O 16	SPECIFIC GRAVITY WATER 1 AIR 1 (A) HYDROGEN 1 (D)	SPECIFIC HEAT AT °C.	VALENCE (PRINCIPAL)	ELECTRICAL CONDUCTIVITY AT °C.	THERMAL CONDUCTIVITY K AT °C. Ag 1.00
44. Molybdenum	Gr. molybdos, lead	Mo	96.0	8.8	.0659	3 or 6		
45. Neodymium	Gr. neos, new and didymos, twin	Nd	144.3	6.956				
46. Neon		Ne	20.2	0.674 A		0		
47. Nickel	Sw. abbr. of kupparnickel	Ni	58.68	8.76	.1084	2 or 3	144200	.1420
48. Nitrogen, Gas	Gr. Niter-forming	N	14.01	0.96737 A	.2438	3 or 5		.0000524
49. Osmium	Gr. osme, odor	Os	190.0	22.48	.03113	2 or 3 m 4 or 8	105300	
50. Oxygen, gas	Gr. acid-forming	O	16.00	1.10535 A	.2175	2		.000563
51. Palladium	Planet Pallas	Pd	106.7	11.65	.0592	2 or 4	97900	.1683
52. Phosphorous yellow	Gr. light-bearing	P	31.04	1.8232 at 20	.202	3 or 5		
53. Phosphorous red				2.296	.1829	3 or 5		
54. Platinum	Sp. platina	Pt	195.2	21.48 at 17.6	.0323	2 or 4	91200	.1664
55. Potassium	Eng. Potash	K	39.10	0.8621 at 20	.1662	1	150500	
56. Praesodymium	Gr. praseos, green and didymos, twin	Pr	140.6	6.4754		3		
57. Radium		Ra	226.4			2		
58. Rhodium	Gr. rhodon, rose	Rh	102.9	12.1	.0580	3		
59. Rubidium	L. rubidius, red	Rb	85.45	1.532 at 20		1		
60. Ruthenium	cryst.	Ru	101.7	12.26	.0611			
61. Samarium	Samarski, a Russian savant	Sm	150.4	7.75		3		

PHYSICAL CONSTANTS OF THE ELEMENTS—Continued

LINEAR COEFFICIENT OF EXPANSION	MELTING POINT °C.	BOILING POINT °C.	DISCOVERED	BY WHOM	WHERE AND HOW FOUND
at °C.					
.....	.....	.....	1782	Hjelm	Mainly in molybdenite (MoS_2).
.....	840	.....	1885	Welsbach	In cerite and other rare minerals.
.....	−253	−243	1895	Ramsay and Travers	Rare gas in the air.
.00001279	1435	.....	1751	Cronstedt	Many metallic ores.
.....	−213	−195.5	1772	Rutherford	In the armosphere and organic matter.
.00000657	2500	.....	1803	Tennant	In iridosmine and native platinum.
.....	−233	−182.5	1774	Priestley	Free in air (Forms one-half the earth's crust combined).
.00001176	1546	.....	1804	Wollaston	Native and with platinum and gold.
.000124	44.2	290	1669	Brandt	In bones and in apatite and many minerals.
.....	350-yel	.....	.....	.....	.....
.00000899	1753	.....	1741	Wood	Mainly as native platinum in river gravels.
.000083	63.6	757.5	1807	Davy	In wood ashes and many rocks.
.....	940	.....	1885	Welsbach	In cerite and other rare minerals.
.....	.....	.....	1903	Madame Curie	In pitchblend.
.0000085 40	1750	.....	1804	Wollaston	With platinum and iridosmine.
.....	38.55	696	1660	Bunsen	In lepidolite, and some mineral springs.
.....	1950	.....	.....	.....	.....
.....	.....	.....	1879	Boisbaudran	In samarskite, cerite and other rare minerals.

PHYSICAL CONSTANTS OF THE ELEMENTS—Continued

NAME	DERIVATION	SYMBOL	ATOMIC WEIGHT O 16	SPECIFIC GRAVITY WATER 1 AIR 1 (A) HYDROGEN 1 (D)	SPECIFIC HEAT AT °C.	VALENCE (PRINCIPAL)	ELECTRICAL CONDUCTIVITY AT °C.	TERMINAL CONDUCTIVITY °C. Ag 1.00
62. Selenium, monoclinic	Gr. selene, moon	Se	79.2	4.47 at 25	.084	2 or 4		
63. Silicon cryst	L. silex, flint	Si	28.3	2.49 at 10	.1697	4		
64. Silver, argentum	Anglo-Saxon Seolfor	Ag	107.88	10.53	.0559	1	681200	1.000
65. Sodium, natrium	Eng. Soda	Na	23.00	0.9375 at 13	.2934	1	211000	0.365
66. Strontium	Strontian, a town in Scotland	Sr	87.63	2.54		2	40300	
67. Sulphur, rhombic	L. sulfur	S	32.07	2.06 at O	.1728	4 or 6		
68. Tantalum	Gr. Tantalus	Ta	181.0	14.49 at 16	.03017	5	60600	
69. Tellurium, cryst	L. tellus, earth	Te	127.5	6.27	.0475	4 or 6	46600	
70. Terbium	Ytterby, a town in Sweden	Tb	159.2			3		
71. Thallium	Gr. thallos, budding twig	Tl	204.0	11.85	.0326	1 or 3	56800	
72. Thorium, cryst	God Thor	Th	232.0	11.23		4		
73. Thulium	Thule Northland	Tm	168.5					
74. Tin, gray stannum	Anglo-Saxon	Sn	119.0	5.846 at 15	.0545	2 or 4	tetragonal 76600	tetragonal .1528
75. Titanium	L. Titanes, Sons of earth	Ti	48.1	3.543	.1125	4 or 5		
76. Tungsten Wolfranium	Sw., heavy stone	W	184.0	18.77	.0336	6		
77. Uranium	Planet Uranus	U	238.5	18.685	.028	6		
78. Vanadium	Goddess Vanadis	V	51.06	6.025 at 15	.0280	3 or 5		
79. Xenon, gas		Xe	130.2	4.422 A		0		

PHYSICAL CONSTANTS OF THE ELEMENTS—Continued

	LINEAR COEFFICIENT OF EXPANSION		MELTING POINT °C.	BOILING POINT °C.	DISCOVERED	BY WHOM	WHERE AND HOW FOUND
		at °C.					
2	.0000368	40	175	690	1817	Berzelius	Mainly in sulphur as an impurity.
3	.00000763		1200	3500	1823	Berzelius	In quarts (SiO_2) most abundant element after oxygen.
4	.00001921		961.5	2050	....	Prehistoric	Native and in many ores.
5	.00072		97.6	877.5	1807	Davy	In common salt (NaCl) and many rocks.
6	.....		900	.....	1808	Davy	In celestipe and strontianite
7	.00006413		114.5	444.6	....	Prehistoric	Native and in many sulphides and sulphates.
8	.000008		2300	.....	1802	Ekeberg	In tantalite and other rare minerals.
9	.0000344		452	1390	1782	Reichenstein	In several rare minerals.
0	.....		.....	.....	1843	Mosander	In rare minerals as gadolinite.
1	.00003021		301.7	1280	1862	Crookes	In pyrites and in flue dust of sulphuric acid works.
2	.....		1515	.....	1828	Berzelius	In thorite and other rare minerals.
3	.....		.....	.....	1879	Cleve	In rare minerals as gadolinite.
4	tetragonal .00002234		tetragonal 232	1525	....	Prehistoric	Mainly in cassiterite (SnO_2).
5	.....		3000	.....	1789	Gregor	Widely diffused in rocks and clays in small amounts.
6	.....		2800	.....	1781	d'Elhujar	Mainly in wolframite($MnFeWO_4$).
7	.....		800	.....	1789	Klaproth	In pitchblend and other rare minerals.
8	....		1680	.....	1830	Sefstron	In vanadinite and other rare minerals.
9	....		−140	−19.1	1895	Ramsay and Travers	Rare element in the air.

PHYSICAL CONSTANTS OF THE ELEMENTS—Continued

NAME	DERIVATION	SYMBOL	ATOMIC WEIGHT O 16	SPECIFIC GRAVITY WATER 1 AIR 1 (A) HYDROGEN 1 (D)	SPECIFIC HEAT AT °C.	VALENCE (PRINCIPAL)	ELECTRICAL CONDUCTIVITY AT °C.	THERMAL CONDUCTIVITY °C. K AT Ag 1.00
80. Ytterbium.	Ytterby, a town in Sweden ...	Yb	172.0	.....	.....	3	.....	.....
81. Yttrium....	Ytterby, a town in Sweden....	Y	89.0	3.80 at 15	.....	3	.....	.....
82. Zinc.....	G. Zink.....	Zn	65.37	7.142 at 16	.09356	2	186000	.2653
83. Zirconium, cryst.....	Per. zargun, gold colored....	Zr	90.6	5.3	.0660	4	.....	.....

PHYSICAL CONSTANTS OF THE ELEMENTS—Continued

LINEAR COEFFICIENT OF EXPANSION	MELTING POINT °C.	BOILING POINT °C.	DISCOVERED	BY WHOM	WHEN AND HOW FOUND
.....	.....	.....	1878	Marignac	In rare minerals as gadolinite.
.....	.....	.....	1828	Wohler	In gadolinite and other rare minerals.
.00002918	419	918	1520	Paracelsus	In ores as oxide silicate, sulphide and carbonate.
.....	.....	.....	1824	Berzelius	In sirkon and other rare minerals.

ONE HUNDRED COMPLETED CHEMICAL EQUATIONS

1. $H_2PtCl_6 + 2KCl = 2HCl + K_2PtCl_6$
2. $K_2PtCl_6 + \text{heat} = 2KCl + Pt + 2Cl_2$
3. $KHC_4H_4O_6 + NaOH = KNaC_4H_4O_6 + H_2O$
4. $Na_2O_2 + 2H_2O = 2NaOH + H_2O_2$
5. $2KMnO_4 + 4H_2SO_4 + 5H_2O_2 = 2KHSO_4 + 2MnSO_4 + 8H_2O + 5O$
6. $2KI + H_2O_2 = 2KOH + I_2$
7. $2AuCl_3 + 3H_2O_2 + 6NaOH = 6NaCl + 6H_2O + 3O_2 + 2Au$
8. $MnCl_2 + 2KOH + H_2O_2 = 2KCl + H_2O + MnO \cdot (OH)_2$ (brown)
9. $2NiCl_2 + 4KOH + H_2O_2 = 4KCl + 2Ni(OH)_3$ (black)
10. $2CoCl_2 + 4KOH + H_2O_2 = 4KCl + 2Co(OH)_3$ (black)
11. $MgCl_2 + Na_2HPO_4 + NH_3 = 2NaCl + MgNH_4PO_4$
12. $2BaCl_2 + K_2Cr_2O_7 + H_2O = 2BaCrO_4 + 2HCl + 2KCl$
13. $AlCl_3 + 3KOH = 3KCl + Al(OH)_3$
14. $Al(OH)_3 + 3KOH = 3H_2O + Al(OK)_3$
15. $2AlCl_3 + 3Na_2S_2O_3 + 3H_2O = 6NaCl + 3S + 3SO_2 + 2Al(OH)_3$
16. $2CrCl_3 + 3(NH_4)_2S + 6H_2O = 6NH_4Cl + 3H_2S + 2Cr(OH)_3$
17. $CrCl_3 + 8NaC_2H_3O_2 + 4H_2O + 3Cl = 6NaCl + 8HC_2H_3O_2 + Na_2CrO_4$
18. $2CrCl_3 + 3MnO_2 + 2H_2O = 3MnCl_2 + 2H_2CrO_4$
19. $K_2Cr_2O_7 + 2KOH = H_2O + 2K_2CrO_4$
20. $K_2Cr_2O_7 + 6FeSO_4 + 7H_2SO_4 = 7H_2O + K_2SO_4 + 3Fe_2(SO_4)_3 + Cr_2(SO_4)_3$
21. $K_2Cr_2O_7 + 6HI + 4H_2SO_4 = K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 6I$
22. $K_2Cr_2O_7 + 14HCl = 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2$
23. $FeCl_2 + 2KCN = 2KCl + Fe(CN)_2$
24. $FeCN_2 + 4KCN = K_4[Fe(CN)_6]$
25. $FeCl_3 + 3NaC_2H_3O_2 = 3NaCl + Fe(C_2H_3O_2)_3$
26. $Fe(C_2H_3O_2)_3 + 2H_2O = 2HC_2H_3O_2 + Fe(OH)_2(C_2H_3O_2)$
27. $K_4[Fe(CN)_6] + 6H_2SO_4 + 6H_2O = 2K_2SO_4 + FeSO_4 + 3(NH_4)_2SO_4 + 6CO$
28. $2MnO_2 + 8HCl = 4H_2O + 2MnCl_2 + 2Cl_2$
29. $2MnSO_4 + 5PbO_2 + 6HNO_3 = 2PbSO_4 + 3Pb(NO_3)_2 + 2H_2O + 2HMnO_4$
30. $2HMnO_4 + 14HCl = 8H_2O + 2MnCl_2 + 5Cl_2$
31. $MnSO_4 + 2Na_2CO_3 + O_2 = 2CO_2 + Na_2SO_4 + Na_2MnO_4$
32. $2KMnO_4 + 10FeSO_4 + 8H_2SO_4 = K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$
33. $2KMnO_4 + 3MnSO_4 + 2H_2O = K_2SO_4 + 5MnO_2 + 2H_2SO_4$
34. $NiCl_2 + 6NH_3 = Ni(NH_3)_6Cl_2$
35. $NiCl_2 + 2KCN = 2KCl + Ni(CN)_2$
36. $Ni(CN)_2 + 2KCN = K_2Ni(CN)_4$
37. $CoCl_2 + 2KNO_2 = Co(NO_2)_2 + 2KCl$
38. $Co(NO_2)_2 + 2HNO_2 = H_2O + NO + Co(NO_2)_3$
39. $Co(NO_2)_3 + 3KNO_2 = K_3Co(NO_2)_6$
40. $3Zn + 8HNO_3 = 3Zn(NO_3)_2 + 4H_2O + 2NO$
41. $Zn + 2KOH = K_2ZnO_2 + H_2$
42. $Zn(OH)_2 + 2NH_4Cl + 4NH_3 = Zn(NH_3)_6Cl_2 + 2H_2O$
43. $ZnCl_2 + 2KCN = 2KCl + Zn(CN)_2$

44. $Zn(CN)_2 + 2KCN = K_2Zn(CN)_4$
45. $3Hg + 8HNO_3 = 3Hg(NO_3)_2 + 4H_2O + 2NO$
46. $HgCl_2 + 2NH_3 = NH_4Cl + HgNH_2Cl$
47. $3HgCl_2 + 2H_2S = 4HCl + Hg_3Cl_2S_2$ (white)
48. $Hg_3Cl_2S_2 + H_2S = 2HCl + 3HgS$
49. $3Hg(NO_3)_2 + 6FeSO_4 = 2Fe(NO_3)_3 + 2Fe_2(SO_4)_3 + 3Hg$
50. $2HgCl + 2NH_3 = NH_4Cl + HgNH_2Cl + Hg$
51. $Hg_2(NO_3)_2 + H_2S = 2HNO_3 + HgS + Hg$
52. $Hg_2(NO_3)_2 + 2KCN = 2KNO_3 + Hg(CN)_2 + Hg$
53. $Pb(NO_3)_2 + 2KOH = Pb(OH)_2 + 2KNO_3$
54. $Pb(OH)_2 + 2KOH = K_2PbO_2 + 2H_2O$
55. $2PbCl_2 + H_2S = 2HCl + PbCl_2.PbS$ (orange)
56. $PbCl_2.PbS + H_2S = 2PbS + 2HCl$
57. $3PbS + 8HNO_3 = 3Pb(NO_3)_2 + 4H_2O + 2NO + 3S$
58. $BiCl_3 + H_2O = 2HCl + BiOCl$
59. $SnCl_2 + 2KOH = 2KCl + Sn(OH)_2$ (white ppt.)
60. $Sn(OH)_2 + 2KOH = K_2SnO_2 + 2H_2O$ (soluble)
61. $BiCl_3 + 6KOH = 2Bi(OH)_3 + 6KCl$
62. $2Bi(OH)_3 + 3K_2SnO_2 = 3H_2O + 3K_2SnO_3 + Bi_2$ (black)
63. $3Cu + 8HNO_3 = 4H_2O + 3Cu(NO_3)_2 + 2NO$
64. $Cu + H_2SO_4 = H_2O + SO_2 + CuO$
65. $CuO + H_2SO_4 = CuSO_4 + H_2O$
66. $2CuSO_4 + 2NH_4OH = (NH_4)_2SO_4 + Cu_2SO_4.(OH)_2$
67. $Cu_2SO_4(OH)_2 + (NH_4)_2SO_4 + 6NH_3 = 2[Cu(NH_3)_4](SO_4) \cdot H_2O$ (soluble, blue)
68. $2Cu(NH_3)_4SO_4 \cdot H_2O + 9KCN = Cu_2(CN)_3NH_4 \cdot K_5 + 2K_2SO_4 + 6NH_3 + H_2O + NH_4CNO$
69. $Cd(NO_3)_2 + 2KCN = 2KNO_3 + Cd(CN)_2$
70. $Cd(CN)_2 + 2KCN = K_2Cd(CN)_4$
71. $K_2Cd(CN)_4 + H_2S = 2KCN + 2HCN + CdS$
72. $H_3AsO_4 + H_2S = H_2O + S + H_3AsO_3$
73. $H_3AsO_3 + 3H_2S = 6H_2O + As_2S_3$
74. $As_2S_3 + 3(NH_4)_2S = 2(NH_4)_3AsS_3$
75. $2(NH_4)_3AsS_3 + 6HCl = 6NH_4Cl + As_2S_3 + 3H_2S$
76. $As_2S_5 + 3(NH_4)_2S = 2(NH_4)_3AsS_4$.
77. $2(NH_4)_3AsS_4 + 6HCl = As_2S_5 + 3H_2S + 4NH_4Cl$. Antimony reactions same as arsenic
78. $3Sn + 4HNO_3 = H_2O + 3H_2SnO_3 + 4NO$
79. $SnCl_2 + H_2S = SnS + 2HCl$
80. $SnS + (NH_4)_2S_2 = (NH_4)_2SnS_3$
81. $(NH_4)_2SnS_3 + 2HCl = 2NH_4Cl + H_2S + SnS_2$
82. $SnCl_4 + 2H_2S = SnS_2 + 4HCl$
83. $SnS_2 + (NH_4)_2S = (NH_4)_2SnS_3$
84. $SnO_2 + 2KCN = 2KCNO + Sn$ (fusion)
85. $2Au + 2HNO_3 + 6HCl = 4H_2O + 2NO + 2AuCl_3$
86. $2AgNO_3 + 2KOH = 2KNO_3 + H_2O + Ag_2O$
87. $Ag_2O + 2NH_4OH = 2(AgNH_3)OH + H_2O$
88. $AgCl + 2NH_4OH = 2Ag(NH_3)_2Cl$
89. $AgCl + 2KCN = KAg(CN)_2 + KCl$
90. $6NH_4OH + 2NH_3 + 3Cl_2 = 6H_2O + 6NH_4Cl + N_2$
91. $6NaOH + 3Cl_2 = 5NaCl + NaClO_3 + 3H_2O$
92. $H_2SO_4 + 2HI = H_2O + H_2SO_3 + I_2$

93. $H_2SO_4 + 8HI = 4H_2O + H_2S + 4I_2$
94. $2Na_2S_2O_3 + I_2 = 2NaI + Na_2S_4O_6$
95. $H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 = (NH_4)_3PO_4.12MoO_3 + 21(NH_4)NO_3 + 12H_2O$
96. $(NH_4)_3PO_4 \cdot 12MoO_3 + 24NH_4OH = (NH_4)_3PO_4 + 12(NH_4)_2MoO_3 + 12H_2O$
97. $6FeSO_4 + 3H_2SO_4 + 2HNO_3 = 3Fe_2(SO_4)_3 + 4H_2O + 2NO$
98. $Fe(NO_3)_2 + NO = Fe(NO_3)_2NO$
99. $KClO_3 + 3H_2SO_4 + 6FeSO_4 = 3Fe_2(SO_4)_3 + 3H_2O + KCl$
100. $Na_2SiO_3 + 2NH_4Cl + 2H_2O = 2NaCl + 2NH_4OH + H_2SiO_3$

THE METHOD OF SOLVING CHEMICAL PROBLEMS

Detailed solutions of a few typical problems are given below. The student should study these carefully, and assure himself that they are fully understood.

1. A "chemical factor" expresses the ratio between a specific quantity of a chemical compound and the *equivalent* quantity of some other body. For example, if it is wished to determine the weight of sulphur which corresponds to a specific weight of barium sulphate, the latter is multiplied by the factor, or ratio, represented by the fraction $\frac{S}{BaSO_4}$, or $\frac{32.07}{233.50} = 0.1373$. It may also be expressed by the proportion $\overset{233.5}{BaSO_4} : \overset{32.07}{S} = \text{wt. } BaSO_4 : x$, from which it is plain that $x = \frac{32.07}{233.50} \cdot \text{wt. } BaSO_4$.

Again, if the weight of FeO in Fe_2O_3 is desired, the factor becomes $\frac{2\,FeO}{Fe_2O_3} = \frac{144.04}{160.04} = 0.9000$. Similarly, the factor for the conversion of KCl to K_2O is $\frac{K_2O}{2\,KCl} = \frac{94.22}{149.12} = 0.6320$. The logarithmic equivalents of these values are called log factors.

In the calculation of these factors, the atomic or molecular relations of the two substances must be kept clearly in mind; thus, it is plainly *incorrect* to express the ratio of ferrous to ferric oxide by the fraction $\frac{FeO}{Fe_2O_3}$, since each molecule of the higher oxide must correspond to two molecules of the lower. Carelessness in this respect is one of the most frequent sources of error.

2. To calculate the volume of a reagent required for a specific operation, it is necessary to know the exact reaction which is to be brought about, and, as with the calculation of factors, to keep in mind the molecular relations between the reagent and the substance reacted upon. For example, to estimate the weight of barium chloride necessary to precipitate the sulphur from 0.1 gram of pure pyrite (FeS_2), the proportion should stand $\overset{120.16}{FeS_2} = x : 0.1$, where $\overset{488.70}{2BaCl_2} \cdot 2\,H_2O$ represents the weight of the chloride required. Each of the two atoms of sulphur will form a mole-

cule of sulphuric acid upon oxidation, which, in turn, will require a molecule of the barium chloride for precipitation. To determine the quantity of the barium chloride required, it is necessary to include in its molecular weight the water of crystallization, since this is inseparable from the chloride when it is weighed. This applies equally to other similar instances.

If the strength of an acid is expressed in percentage by weight, due regard must be paid to its specific gravity. For example, hydrochloric acid (sp. gr. 1.12) contains 23.8 per cent HCl by weight; *i.e.*, 0.2666 gram.

3. No rules for universal application to "indirect gravimetric analyses" can be laid down. A single example will be explained.

Given a mixture of KCl + NaCl weighing 0.15 gram, which contains 53 per cent chlorine, to calculate the weight of KCl and NaCl in the mixture.

The weight of chlorine in the mixture is (0.15×0.53) or 0.0795 gram. Assuming that this chlorine was all in combination with potassium, the corresponding weight of KCl would be 0.1672 gram (Cl : KCl = 0.0795 : 0.1672). This is an excess of 0.0172 gram over the actual weight of the mixture, and it is plain that this difference is occasioned by the replacement of certain of the molecules of potassium chloride, weighing 74.56 units, by molecules of sodium chloride weighing 58.50 units. To express this, let it be supposed that the mixture is made up of n molecules $\overset{74.56}{\text{KCl}}$ and n' molecules NaCl; then it may be said that $n\ \overset{74.56}{\text{KCl}} + n'\ \overset{58.50}{\text{NaCl}} = 0.15$ gram, and $n\ \overset{74.56}{\text{KCl}} + n'\ \overset{74.56}{\text{KCl}} = 0.1672$ gram, then by subtracting the first equation from the second it is shown that $n'\ (\overset{74.56}{\text{KCl}} - \overset{58.50}{\text{NaCl}}) = 0.0172$ gram. That is, the difference in weight is equal to n' times the difference in the molecular weights of the two chlorides. The actual weight of NaCl present (x) is equal to $58.50n'$, or, since $n' = \frac{0.0172}{74.56 - 58.50}$, $x = 58.50 \left(\frac{0.0172}{74.56 - 58.50}\right)$. This may be expressed in the form $(74.56 - 58.50) : 58.50 = 0.0172 : x$, from which $x = 0.0626$. The weight of NaCl subtracted from that of the mixture gives the weight of KCl.

The weights of the chlorides may also be calculated algebraically by solving the equations $x + y = 0.15$ and $\frac{35.45}{74.56}x + \frac{35.45}{58.50}y = 0.0795$, where x is the weight of KCl and y is the weight of NaCl in the mixture.

4. It is sometimes desirable to weigh out such a quantity of substance for analysis, that the number of cubic centimeters of standard solution entering into the reaction shall represent directly the percentage of the desired constituent. This may be readily done, by considering the relation of the solution to a normal solution and the atomic or molecular weight of the desired component. For example, suppose it is desired to calculate such a weight for K_2CO_3 in pearl ash, when a half-normal acid solution is used. Since half-normal acid and alkali solutions are equiva-

lent, and since by definition the half-normal K_2CO_3 solution contains 34.55 grams per liter, each cubic centimeter of the acid solution contains 34.55 grams per liter, each cubic centimeter of the acid solution must be equivalent to 0.03455 gram K_2CO_3. Hence, 100 cc. would neutralize 3.455 grams pure K_2CO_3 and this becomes the desired weight of the pearl ash. Similarly the required weight of limonite where the iron (Fe) is to be determined by means of a deci-normal $K_2Cr_2O_7$ solution is 0.5602 gram.

5. One of the most frequently recurring cases in volumetric analysis is that in which it is wished to express the value of a specific solution in terms of some substance other than that against which it has been standardized as for instance, the value of a permanganate solution which has been standardized against oxalic acid, in terms of iron. Although such problems apparently vary widely, there are common principles which can be applied to them all. These are stated below, and the student should assure himself that they are fully understood.

Suppose, for example, it is desired to find the iron value (Fe of a permanganate solution, of which 1 cc. is equivalent to 0.006302 gram $C_2H_2O_4 \cdot 2H_2O$.

From a comparison of the reactions it is seen that 10 molecules of ferrous sulphate and 5 molecules of oxalic acid each react with the same amount (2 molecules) of the permanganate. These two quantities being, then, equivalent to the same third quantity, must be equivalent to each other; in other words, 10 molecules of ferrous sulphate and 5 molecules of oxalic acid have the same reducing power. But, as stated above, the value is desired in terms of metallic iron (Fe), not $FeSO_4$, but as it is plain that $10FeSO_4$ are equivalent to 10Fe, it is proper to make the proportion

$$\overset{560.2}{10\,Fe} : \overset{630.25}{5C_2H_2O_4 \cdot 2\,H_2O} = x : 0.006302$$

in which $x = 0.005602$ gram. Here, again, as in example 2, it is necessary to include the water of crystallization in the molecular weight of the oxalic acid, as it is weighed with it.

The same conclusion is arrived at, if we consider the relation of the solution to the normal. As given, it is deci-normal and must, therefore, be equivalent to a deci-normal solution of iron. From the equations cited, it is seen that $10FeSO_4$, unite with 5O, therefore each molecule is equivalent to 1 hydrogen atom in reducing power. The normal solution must, then, contain 1 gram-molecule of ferrous sulphate, or 56.02 grams Fe, and each cubic centimeter of the deci-normal solution would contain 0.005602 gram, the value obtained above.

Again, suppose the value of the same permanganate solution were desired in terms of molybdenum (Mo), the reactions with permanganate being

$$5Mo_{12}O_{19} + 17Mn_2O_7 = 60MoO_3 + 34MnO, \text{ and}$$
$$5C_2H_2O_4 \cdot 2H_2O + Mn_2O_7 = 2MnO + 10CO_2 + 15H_2O.$$
(Mn_2O_7 is the anhydride of $HMnO_4$.)

It is plain that in these equations as they stand, the molecular quantities of oxidizing agent are not equal. They can be made so by simply multiplying the second equation by 17, and they then become,

$$5Mo_{12}O_{19} + 17Mn_2O_7 = 34MnO + 60MoO_3, \text{ and}$$
$$85C_2H_2O_4 \cdot 2H_2O + 17Mn_2O_7 = 34MnO + 170\ CO_2 + 255\ H_2O.$$

It is now possible to reason in the same way as before, and to conclude that 85 molecules of the oxalic acid have the same reducing power as 5 molecules of the oxide $Mo_{12}O_{19}$, or 60 atoms of molybdenum. Accordingly,

$$\overset{5758.8}{60Mo} : \overset{10714.25}{85C_2H_2O_4.2H_2O} : : x : 0.006302$$

in which x 0.003387 gram.

Since $5Mo_{12}O_{19}$ unite with 85O, a normal solution of the former as a reducing agent, would contain 1/170 of the 5 gram-molecules or 33.87 grams Mo, and the deci-normal solution 3.387 grams per liter. This agrees with the values already obtained.

6. It is sometimes necessary to calculate the value of solutions according to the principles just explained, when several successive reactions are involved. Such problems may be solved by a series of proportions, but it is usually possible, after stating these to eliminate the common factors and solve but a single one.

For example, suppose it is desired to express the value of a permanganate solution, of which 1 cc. = 0.008 gram iron (Fe), in terms of calcium oxide (CaO). The reactions involved in the volumetric determination of calcium are the following; $CaCl_2 + (NH_4)_2C_2O_4 = CaC_2O_4 + 2NH_4Cl$; $CaC_2O_4 + H_2SO_4 + 2H_2O = CaSO_4 + C_2H_2O_4 \cdot 2H_2O$; $5C_2H_2O_4 \cdot 2H_2O + 2KMnO_4 + 3H_2SO_4 = K_2SO_4 + MnSO_4 + 10CO_2 + 18H_2O$.

From the considerations stated under 5, the following proportions may be made.

$$10Fe : 5C_2H_2O_4 \cdot 2H_2O = 0.008 : x$$
$$5C_2H_2O_4 \cdot 2H_2O : 5CaC_2O_4 = x : y$$
$$5CaC_2O_4 : 5CaO = y : x$$

Canceling the common factors, there remains simply

$$\overset{560.2}{10Fe} : \overset{280.4}{5\ CaO} = 0.008 : z$$

Similarly, from the reactions, the equivalent of the iodine liberated may be calculated in terms of MnO_2 as follows: Supposing the weight of iodine to be 0.5 gram then

$$2I : 2KI = 0.5 : x$$
$$2KI : 2Cl = x : y$$
$$2Cl : 2HCl = y : z$$
$$2HCl : MnO_2 = z : w$$

Canceling the common factors, there remains

$$2I : MnO_2 = 0.5 : w$$

To solve such problems as 5 and 6, it is necessary to know the reactions involved, and the way in which the various components break up; then to compare the reactions and to search for those molecular quantities of the compounds in question, which are *equivalent* in their action upon a common agent. Having found these, as shown above, express the molecular ratio between them in the form of a proportion; as, for example, $2\,\overset{253.7}{I} : \overset{86.99}{MnO_2} = 0.5 : w$. Expressed in the form $w = \frac{86.99}{253.7}\,0.5$, it is plain that this ratio is in no way different in principle from the chemical factor mentioned in paragraph 1; indeed, it is the factor for the conversion of iodine to manganese dioxide.

DENSITY OF WATER AT 0° TO 36°

Weight in grams of 1 cc. of water free from air at temperatures of 0 to 36°C. by the hydrogen thermometer—according to Thiesen, Scheel, and Diesselhorst Wiss. Abh. d. Phys.—Techn. Reichsanst. 3, 68: 1900.

DEGREES	TENTHS OF DEGREES									
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.999868	874	881	887	893	899	905	911	916	922
1	927	932	936	941	945	950	954	957	961	965
2	968	971	974	977	980	982	985	987	989	991
3	992	994	995	996	997	998	999	999	*000	*000
4	1.000000	000	000	*999	*999	*998	*997	*996	*995	*993
5	0.999992	990	988	986	984	982	979	977	974	971
6	986	965	962	958	954	951	947	943	938	934
7	929	925	920	915	910	904	899	893	888	882
8	876	870	864	857	851	844	837	830	823	816
9	808	801	793	785	778	769	761	753	744	736
10	727	718	709	700	691	681	672	662	652	642
11	632	622	612	601	591	580	569	558	547	536
12	525	513	502	490	478	466	454	442	429	417
13	404	391	379	366	353	339	326	312	299	285
14	271	257	243	229	215	200	186	171	156	141
15	126	111	096	081	065	050	034	018	002	*986
16	0.998970	953	937	920	904	887	870	853	836	819
17	801	784	766	749	731	713	695	677	659	640
18	622	603	585	566	547	528	509	490	471	451
19	432	412	392	372	352	332	312	292	271	251
20	230	210	189	168	147	126	105	083	062	040
21	019	*997	*975	*953	*931	*909	*887	*864	*842	*819
22	0.997797	774	751	728	705	682	659	635	612	588
23	565	541	517	493	469	445	421	396	372	347
24	323	298	273	248	223	198	173	147	122	096
25	071	045	019	*994	*968	*941	*915	*889	*863	*836
26	0.996810	783	756	730	703	676	648	621	594	567
27	539	512	484	456	428	400	372	344	316	288
28	259	231	202	174	145	116	087	058	029	000
29	0.995971	941	912	882	853	823	793	763	733	703
30	0.99567	537	505	473	440	406	371	336	299	262
40	224	186	147	107	066	025	*982	*940	*896	*852
50	0.98807	762	715	669	621	573	525	475	425	375
60	324	272	220	167	113	059	005	*950	*894	*838
70	0.97781	723	666	607	548	489	429	368	307	245
80	183	121	057	*994	*930	*865	*800	*734	*668	*601
90	0.96534	467	399	330	261	192	122	051	*981	*909
100	0.95838	765	693							

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10

Length

INCHES		MILLIMETERS	INCHES		CENTIMETERS	FEET		METERS	U. S. YARDS		METERS	U. S. MILES		KILOMETERS
0.03937	=	1	0.3937	=	1	1	=	0.304801	1	=	0.914402	0.62137	=	1
0.07874	=	2	0.7874	=	2	2	=	0.609601	1.093611	=	1	1	=	1.60935
0.11811	=	3	1	=	2.54001	3	=	0.914402	2	=	1.828804	1.24274	=	2
0.15748	=	4	1.1811	=	3	3.28083	=	1	2.187222	=	2	1.86411	=	3
0.19685	=	5	1.5748	=	4	4	=	1.219202	3	=	2.743205	2	=	3.21869
0.23622	=	6	1.9685	=	5	5	=	1.524003	3.280833	=	3	2.48548	=	4
0.27559	=	7	2	=	5.08001	6	=	1.828804	4	=	3.657607	3	=	4.82804
0.31496	=	8	2.3622	=	6	6.56167	=	2	4.374444	=	4	3.10685	=	5
0.35433	=	9	2.7559	=	7	7	=	2.133604	5	=	4.572009	3.72822	=	6
1	=	25.4001	3	=	7.62002	8	=	2.438405	5.468056	=	5	4	=	6.43739
2	=	50.8001	3.1496	=	8	9	=	2.743205	6	=	5.486411	4.34959	=	7
3	=	76.2002	3.5433	=	9	9.84250	=	3	6.561667	=	6	4.97096	=	8
4	=	101.6002	4	=	10.16002	13.12333	=	4	7	=	6.400813	5	=	8.04674
5	=	127.0003	5	=	12.70003	16.40417	=	5	7.655278	=	7	5.59233	=	9
6	=	152.4003	6	=	15.24003	19.68500	=	6	8	=	7.315215	6	=	9.65608
7	=	177.8004	7	=	17.78004	22.96583	=	7	8.748889	=	8	7	=	11.26543
8	=	203.2004	8	=	20.32004	26.24667	=	8	9	=	8.229616	8	=	12.87478
9	=	228.6005	9	=	22.86005	29.52750	=	9	9.842500	=	9	9	=	14.48412

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Area

SQUARE INCHES		SQUARE MILLIMETERS	SQUARE INCHES		SQUARE CENTIMETERS	SQUARE FEET		SQUARE METERS	SQUARE YARDS		SQUARE METERS	SQUARE MILES		SQUARE KILOMETERS
0.00155	=	1	0.1550	=	1	1	=	0.09290	1	=	0.8361	0.3861	=	1
0.00310	=	2	0.3100	=	2	2	=	0.18581	1.1960	=	1	0.7722	=	2
0.00465	=	3	0.4650	=	3	3	=	0.27871	2	=	1.6723	1	=	2.5900
0.00620	=	4	0.6200	=	4	4	=	0.37161	2.3920	=	2	1.1583	=	3
0.0075	=	5	0.7750	=	5	5	=	0.46452	3	=	2.5084	1.5444	=	4
0.00930	=	6	0.9300	=	6	6	=	0.55742	3.5880	=	3	1.9305	=	5
0.01085	=	7	1	=	6.452	7	=	0.65032	4	=	3.3445	2	=	5.1800
0.01240	=	8	1.0850	=	7	8	=	0.74323	4.7839	=	4	2.3166	=	6
0.01395	=	9	1.2400	=	8	9	=	0.83613	5	=	4.1807	2.7027	=	7
1	=	645.16	1.3950	=	9	10.764	=	1	5.9799	=	5	3	=	7.7700
2	=	1,290.33	2	=	12.903	21.528	=	2	6	=	5.0168	3.0888	=	8
3	=	1,935.49	3	=	19.355	32.292	=	3	7	=	5.8529	3.4749	=	9
4	=	2,580.65	4	=	25.807	43.055	=	4	7.1759	=	6	4	=	10.3600
5	=	3,225.81	5	=	32.258	53.819	=	5	8	=	6.6890	5	=	12.9500
6	=	3,870.98	6	=	38.710	64.583	=	6	8.3719	=	7	6	=	15.5400
7	=	4,516.14	7	=	45.161	75.347	=	7	9	=	7.5252	7	=	18.1300
8	=	5,161.30	8	=	51.613	86 111	=	8	9.5679	=	8	8	=	20.7200
9	=	5,806.46	9	=	58.065	96.875	=	9	10.7639	=	9	9	=	23.3100

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Volume

CUBIC INCHES		CUBIC MILLIMETERS	CUBIC INCHES		CUBIC CENTIMETERS	CUBIC FEET		CUBIC METERS	CUBIC YARDS		CUBIC METERS
0.000061	=	1	0.0610	=	1	1	=	0.02832	1	=	0.7646
0.000122	=	2	0.1220	=	2	2	=	0.05663	1.3079	=	1
0.000183	=	3	0.1831	=	3	3	=	0.08495	2	=	1.5291
0.000244	=	4	0.2441	=	4	4	=	0.11327	2.6159	=	2
0.000305	=	5	0.3051	=	5	5	=	0.14159	3	=	2.2937
0.000366	=	6	0.3661	=	6	6	=	0.16990	3.9238	=	3
0.000427	=	7	0.4272	=	7	7	=	0.19822	4	=	3.0582
0.000488	=	8	0.4882	=	8	8	=	0.22654	5	=	3.8228
0.000549	=	9	0.5492	=	9	9	=	0.25485	5.2318	=	4
1	=	16,387.2	1	=	16.3872	35.314	=	1	6	=	4.5874
2	=	32,774.3	2	=	32.7743	70.629	=	2	6.5397	=	5
3	=	49,161.5	3	=	49.1615	105.943	=	3	7	=	5.3519
4	=	65,548.6	4	=	65.5486	141.258	=	4	7.8477	=	6
5	=	81,935.8	5	=	81.9358	176.572	=	5	8	=	6.1165
6	=	98,323.0	6	=	98.3230	211.887	=	6	9	=	6.8810
7	=	114,710.1	7	=	114.7101	247.201	=	7	9.1556	=	7
8	=	131,097.3	8	=	131.0973	282.516	=	8	10.4635	=	8
9	=	147,484.5	9	=	147.4845	317.830	=	9	11.7715	=	9

AREA—Continued

ACRES		HECTARES
1	=	0.4047
2	=	0.8094
2.471	=	1
3	=	1.2141
4	=	1.6187
4.942	=	2
5	=	2.0234
6	=	2.4281
7	=	2.8328
7.413	=	3
8	=	3.2375
9	=	3.6422
9.884	=	4
12.355	=	5
14.826	=	6
17.297	=	7
19.768	=	8
22.239	=	9

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Capacity

MILLILITERS (cc.)		U. S. LIQUID OUNCES	MILLILITERS (cc.)		U. S. APOTHECARIES' DRAMS	U. S. APOTHECARIES' SCRUPLES		MILLILITERS (cc.)	U. S. LIQUID QUARTS		LITERS	U. S. LIQUID GALLONS		LITERS
1	=	0.03381	1	=	0.2705	0.8115	=	1	1	=	0.94636	0.26417	=	1
2	=	0.06763	2	=	0.5410	1	=	1.2322	1.05668	=	1	0.52834	=	2
3	=	0.10144	3	=	0.8115	1.6231	=	2	2	=	1.89272	0.79251	=	3
4	=	0.13526	3.6967	=	1	2	=	2.4645	2.11336	=	2	1	=	3.78543
5	=	0.16907	4	=	1.0820	2.4346	=	3	3	=	2.83908	1.05668	=	4
6	=	0.20288	5	=	1.3525	3	=	3.6967	3.17005	=	3	1.32085	=	5
7	=	0.23670	6	=	1.6231	3.2461	=	4	4	=	3.78543	1.58502	=	6
8	=	0.27051	7	=	1.8936	4	=	4.9290	4.22673	=	4	1.84919	=	7
9	=	0.30432	7.3934	=	2	4.0577	=	5	5	=	4.73179	2	=	7.57087
29.574	=	1	8	=	2.1641	4.8692	=	6	5.28341	=	5	2.11336	=	8
59.147	=	2	9	=	2.4346	5	=	6.1612	6	=	5.67815	2.37753	=	9
88.721	=	3	11.0901	=	3	5.6807	=	7	6.34009	=	6	3	=	11.35630
118.295	=	4	14.7869	=	4	6	=	7.3934	7	=	6.62451	4	=	15.14174
147.869	=	5	18.4836	=	5	6.4923	=	8	7.39677	=	7	5	=	18.92717
177.442	=	6	22.1803	=	6	7	=	8.6257	8	=	7.57088	6	=	22.71261
207.016	=	7	25.8770	=	7	7.3038	=	9	8.45345	=	8	7	=	26.49804
236.590	=	8	29.5737	=	8	8	=	9.8579	9	=	8.51723	8	=	30.28348
266.163	=	9	33.2704	=	9	9	=	11.0901	9.51014	=	9	9	=	34.06891

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

U. S. DRY QUARTS	LITERS	U. S. PECKS	LITERS	DEKA-LITERS	U. S. PECKS.	U. S. BUSHELS	HECTO-LITERS	U. S. BUSHELS PER ACRE	HECTO-LITERS PER HECTARE
0.9081 = **1**		0.11351 = **1**		0.8810 = **1**		**1** = 0.35239		**1** = 0.87078	
1 = 1.1012		0.22702 = **2**		**1** = 1.1351		**2** = 0.70479		1.14840 = **1**	
1.8162 = **2**		0.34053 = **3**		1.7620 = **2**		2.83774 = **1**		**2** = 1.74156	
2 = 2.2025		0.45404 = **4**		**2** = 2.2702		**3** = 1.05718		2.29680 = **2**	
2.7242 = **3**		0.56755 = **5**		2.6429 = **3**		**4** = 1.40957		**3** = 2.61233	
3 = 3.3037		0.68106 = **6**		**3** = 3.4053		**5** = 1.76196		3.44519 = **3**	
3.6323 = **4**		0.79457 = **7**		3.5239 = **4**		5.67548 = **2**		**4** = 3.48311	
4 = 4.4049		0.90808 = **8**		**4** = 4.5404		**6** = 2.11436		4.59359 = **4**	
4.5404 = **5**		**1** = 8.80982		4.4049 = **5**		**7** = 2.46675		**5** = 4.35389	
5 = 5.5061		1.02157 = **9**		**5** = 5.6755		**8** = 2.81914		5.74199 = **5**	
5.4485 = **6**		**2** = 17.61964		5.2859 = **6**		8.51323 = **3**		**6** = 5.22467	
6 = 6.6074		**3** = 26.42946		**6** = 6.8106		**9** = 3.17154		6.89039 = **6**	
6.3565 = **7**		**4** = 35.23928		6.1669 = **7**		11.35097 = **4**		**7** = 6.09545	
7 = 7.7086		**5** = 44.04910		**7** = 7.9457		14.18871 = **5**		**8** = 6.96622	
7.2646 = **8**		**6** = 52.85892		7.0479 = **8**		17.02645 = **6**		8.03879 = **7**	
8 = 8.8098		**7** = 61.66874		7.9288 = **9**		19.86420 = **7**		**9** = 7.83700	
8.1727 = **9**		**8** = 70.47856		**8** = 9.0808		22.70194 = **8**		9.18719 = **8**	
9 = 9.9110		**9** = 79.28838		**9** = 10.2159		25.53968 = **9**		10.33558 = **9**	

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Weight (or Mass)

GRAINS		GRAMS	AVOIRDUPOIS OUNCES		GRAMS	TROY OUNCES		GRAMS	AVOIRDUPOIS POUNDS		KILOGRAMS	TROY POUNDS		KILOGRAMS
1	=	0.06480	0.03527	=	1	0.03215	=	1	1	=	0.45359	1	=	0.37324
2	=	0.12960	0.07055	=	2	0.06430	=	2	2	=	0.90718	2	=	0.74648
3	=	0.19440	0.10582	=	3	0.09645	=	3	2.20462	=	1	2.67923	=	1
4	=	0.25920	0.14110	=	4	0.12860	=	4	3	=	1.36078	3	=	1.11973
5	=	0.32399	0.17637	=	5	0.16075	=	5	4	=	1.81437	4	=	1.49297
6	=	0.38879	0.21164	=	6	0.19290	=	6	4.40924	=	2	5	=	1.86621
7	=	0.45359	0.24692	=	7	0.22506	=	7	5	=	2.26796	5.35846	=	2
8	=	0.51839	0.28219	=	8	0.25721	=	8	6	=	2.72155	6	=	2.23945
9	=	0.58319	0.31747	=	9	0.28936	=	9	6.61387	=	3	7	=	2.61269
15.4324	=	1	1	=	28.3495	1	=	31.10348	7	=	3.17515	8	=	2.98593
30.8647	=	2	2	=	56.6991	2	=	62.20696	8	=	3.62874	8.03769	=	3
46.2971	=	3	3	=	85.0486	3	=	93.31044	8.81849	=	4	9	=	3.35918
61.7294	=	4	4	=	113.3981	4	=	124.41392	9	=	4.08233	10.71691	=	4
77.1618	=	5	5	=	141.7476	5	=	155.51740	11.02311	=	5	13.39614	=	5
92.5941	=	6	6	=	170.0972	6	=	186.62088	13.22773	=	6	16.07537	=	6
108.0265	=	7	7	=	198.4467	7	=	217.72437	15.43236	=	7	18.75460	=	7
123.4589	=	8	8	=	226.7962	8	=	248.82785	17.63698	=	8	21.43383	=	8
138.8912	=	9	9	=	255.1457	9	=	279.93133	19.84160	=	9	24.11306	=	9

COMPOSITION OF FREEZING MIXTURES

Lowest temperature	*Composition of mixture*
−22.4°C	30 grams salt (NaCl) 100 grams ice finely pulverized and well mixed.
−37°C	Equal weights H_2SO_4 and ice.
−55°C	42.5 parts anhydrous calcium chloride and 100 parts ice.

IONIZATION CONSTANTS OF ACIDS AND BASES

Formic acid	0.000214
Acetic acid	0.000018
Chloracetic acid	0.00155
Trichloracetic acid	1.21
Benzoic acid	0.00006
Ammonium hydroxide	0.000023
Carbonic acid	0.0000003040
Hydrogen sulphide	0.0000000570
Boric acid	0.0000000017
Hydrocyanic acid	0.0000000013

MISCELLANEOUS DATA AND FORMULAE

3.14159

Radius of circle, R; its diameter, D; then D, 2R.
The circumference, 2R; the area, 2R.
The radius of a sphere, R; the surface area, 4R.
The volume, 4/3R.
Area of a triangle of base, b; height, h; 1/2 b h

ELECTROMOTIVE FORCE SERIES OF METALS

Al	1.276	Pb	0.148
Mn	1.075	H	0.000
Zn	0.770	Cu	0.336
Cd	0.420	Hg	0.748
Fe	0.340	Ag	0.771
Co	0.232	Pt	0.863
Ni	0.228	Au	1.079
Sn	0.192		

TABLES SHOWING THE FUNCTIONS, USES AND COMPOSITIONS OF FOODS

Functions and Uses of Food in the Body

Protein.—Builds and repairs tissue:

Albumen (white of eggs)
Casein (curd of milk)
Lean meat
Gluten of grains

} All serve as fuel to yield energy in the forms of heat and muscular power

Fats.—Are stored as fat:

Fat of meats, butter, olive oil, oils of corn, wheat and other grains

Carbohydrates.—Are transformed into fat:

Sugar, starch, etc.

Mineral Matter of Ash.—Share in forming bones and assist in processes of digestion.

Phosphates of lime potash, soda, etc.

Food is that which, taken into the body, builds tissue and yields energy.

Dietary Standards

For a man in full vigor at moderate muscular work, per day

	PROTEIN	ENERGY
	grams	*calories*
Food eaten	100	3.500
Food digested	95	3.200

Mineral Matter (required per day.)

	grams
Phosphoric acid, (P_2O_5)	3 to 4
Sulphuric acid, (SO_3)	2 to 3.5
Potassium oxide, (K_2O)	2 to 3
Sodium oxide, (Na_2O)	4 to 6
Calcium oxide, (CaO)	0.7 to 1.0
Magnesium oxide, (MgO)	0.3 to 0.5
Iron, (Fe)	0.006 to 0.012
Chlorine, (Cl)	6 to 8

These tables are compiled from charts of the United States Department of Agriculture, prepared by C. F. Langworthy, expert in charge of nutrition investigations.

NAME OF THE FOOD MATERIAL	PROTEIN	FAT	CARBO-HYDRATES	ASH	WATER	FUEL VALUE IN CALORIES PER LB.
Apple	0.4	0.5	14.2	0.3	84.6	290
Bacon	9.4	67.4		4.4	18.8	3030
Beef suet	4.7	81.8		0.3	13.2	3510
Butter	1.0	85.0		3.0	11.0	3410
Buckwheat	10.0	2.2	73.2	2.0	12.6	1600
Beefsteak	18.6	18.5		1.0	61.9	1130
Buttermilk	3.0	0.5	4.8	0.7	91.0	160
Bean, fresh shelled	9.4	0.6	29.1	2.0	58.9	740
Bean, green string	2.3	0.3	7.4	0.8	89.2	195
Bean, navy dry	22.5	1.8	59.6	3.5	12.6	1600
Banana	1.3	0.6	22.0	0.8	75.3	460
Cod fish, fresh	12.8	0.4		1.2	82.6	325
Cod fish, salt	21.5	0.3		24.7	53.5	410
Corn, dried	10.0	4.3	73.4	1.5	10.8	1800
Corn, green	3.1	1.1	19.7	0.7	75.4	500
Corn bread	7.9	4.7	46.3	2.2	38.9	1205
Cream cheese	25.9	33.7	2.4	3.8	34.2	1950
Cottage cheese	20.9	1.0	4.3	1.8	72.0	510
Cream	2.5	18.5	4.5	0.5	74.0	865

TABLES SHOWING THE FUNCTIONS, USES AND COMPOSITIONS OF FOODS—Continued

NAME OF THE FOOD MATERIAL	PROTEIN	FAT	CARBOHYDRATES	ASH	WATER	FUEL VALUE IN CALORIES PER LB.
Candy stick			96.5	0.5	3.0	1785
Celery	1.1		3.4	1.0	94.5	85
Chestnut	10.7	7.0	74.2	2.2	5.9	1875
Cocoanut, dried	6.3	57.4	31.5	1.3	3.5	3125
Dried beef	30.0	6.6		9.1	54.3	840
Egg, whole	14.8	10.5		1.0	73.7	700
Egg, white	13.0	0.2		0.6	86.2	265
Egg, yolk	16.1	33.3		1.1	49.5	1608
Fig, dried	4.3	0.3	74.2	2.4	18.8	1475
Fruit, canned	1.1	0.1	21.1	0.5	77.2	415
Grapes	1.3	1.6	19.2	0.5	77.4	450
Grape juice, unfermented	0.2		7.4	0.2	92.2	150
Herring, smoked	36.4	15.8		13.2	34.6	1355
Honey	0.4		81.2	0.2	18.2	1520
Jelly, fruit			78.3	0.7	21.0	1455
Lard		100.0				4080
Lamb chop	17.6	28.3		1.0	53.1	1540
Mackerel	18.3	7.1		1.2	73.4	645
Macaroni	3.0	1.5	15.8	1.3	78.4	415
Milk, whole	3.3	4.0	5.0	0.7	87.0	310
Milk, skimmed	3.4	0.3	5.1	0.7	90.5	165
Molasses	2.4		69.3	3.2	25.1	1290
Oat	11.8	5.0	69.2	3.0	11.0	1720
Olive oil		100.0				4080
Oyster	6.2	1.2	3.7	2.0	86.9	235
Onion	1.6	0.3	9.9	0.6	87.6	225
Pork chop	16.9	30.1		1.0	52.0	1580
Parsnip	1.6	0.5	13.5	1.4	83.0	230
Potato	2.2	0.1	18.4	1.0	78.3	385
Peanut	25.8	38.6	22.4	2.0	9.2	2500
Peanut butter	29.3	46.5	17.1	5.0	2.1	2825
Rye	12.2	1.5	73.9	1.9	10.5	1750
Rice	8.0	2.0	77.0	1.0	12.0	1720
Rolled oats, cooked	2.8	0.5	11.5	0.7	84.5	285
Raisins	2.6	3.3	76.1	3.4	14.6	1605
Smoked ham	16.1	38.8		4.8	40.3	1940
Sugar granulated			100.0			1860
Sugar, maple			82.8	0.9	16.3	1540
Strawberry	1.0	0.6	7.4	0.6	90.4	180
Toasted bread	11.5	1.6	61.2	1.7	24.0	1420
Wheat	12.2	1.7	73.7	1.8	10.6	1750
White bread	9.2	1.3	53.1	1.1	35.3	1215
Whole wheat bread	9.7	0.9	49.7	1.3	38.4	1140
Walnut	16.6	63.4	16.1	1.4	2.5	3285

REDUCTION OF GAS. VOLUMES TO 0° AND 760 MM.

Volume at 0° and 750 mm. $= v\left(\frac{1}{760\,(1+0.00367\,t)}\right)$ (and $P-p$).

v = observed volume of gas
t = observed temperature of gas in degrees Centigrade
P = observed barometric pressure, corrected, in millimeters
p = tension of aqueous vapor in millimeters

The logarithm of the volume at 0° and 76 mm. is obtained by adding the logs of v and $\left(\frac{1}{760\,(1+0.00367\,t)}\right)$ and $(P-p)$

°C.	LOGARITHM OF $\frac{1}{760\,(1+0.00367t)}$	TENSION AQUEOUS VAPOR	°C.	LOGARITHM OF $\frac{1}{760\,(1+0.00367t)}$	TENSION AQUEOUS VAPOR	°C.	LOGARITHM OF $\frac{1}{760\,(1+0.00367t)}$	TENSION AQUEOUS VAPOR
		mm.			*mm.*			*mm.*
0.0	3.11919	4.60	6.4	3.10911	7.19	12.8	3.09925	11.04
0.2	3.11887	4.65	6.6	3.10880	7.29	13.0	3.09895	11.19
0.4	3.11855	4.71	6.8	3.10848	7.39	13.2	3.09864	11.33
0.6	3.11824	4.78	7.0	3.10818	7.49	13.4	3.09834	11.48
0.8	3.11792	4.85	7.2	3.10786	7.60	13.6	3.09804	11.63
1.0	3.11760	4.92	7.4	3.10755	7.70	13.8	3.09773	11.78
1.2	3.11728	4.99	7.6	3.10724	7.81	14.0	3.09743	11.94
1.4	3.11696	5.06	7.8	3.10693	7.91	14.2	3.09713	12.09
1.6	3.11665	5.14	8.0	3.10662	8.02	14.4	3.09682	12.25
1.8	3.11633	5.21	8.2	3.10631	8.13	14.6	3.09652	12.41
2.0	3.11601	5.29	8.4	3.10600	8.24	14.8	3.09622	12.57
2.2	3.11570	5.36	8.6	3.10570	8.36	15.0	3.09592	12.73
2.4	3.11538	5.44	8.8	3.10538	8.47	15.2	3.09561	12.89
2.6	3.11507	5.52	9.0	3.10508	8.58	15.4	3.09531	13.06
2.8	3.11475	5.60	9.2	3.10477	8.70	15.6	3.09501	13.23
3.0	3.11443	5.68	9.4	3.10446	8.82	15.8	3.09471	13.39
3.2	3.11412	5.76	9.6	3.10415	8.94	16.0	3.09441	13.57
3.4	3.11380	5.84	9.8	3.10384	9.06	16.2	3.09411	13.74
3.6	3.11349	5.92	10.0	3.10354	9.18	16.4	3.09381	13.91
3.8	3.11317	6.00	10.2	3.10323	9.30	16.6	3.09351	14.09
4.0	3.11286	6.09	10.4	3.10292	9.43	16.8	3.09321	14.27
4.2	3.11255	6.17	10.6	3.10262	9.55	17.0	3.09291	14.45
4.4	3.11223	6.26	10.8	3.10231	9.68	17.2	3.09261	14.63
4.6	3.11192	6.35	11.0	3.10200	9.81	17.4	3.09231	14.82
4.8	3.11160	6.44	11.2	3.10170	9.94	17.6	3.09201	15.00
5.0	3.11129	6.53	11.4	3.10139	10.07	17.8	3.09171	15.19
5.2	3.11098	6.62	11.6	3.10108	10.21	18.0	3.09141	15.38
5.4	3.11067	6.71	11.8	3.10178	10.34	18.2	3.09111	15.58
5.6		6.81	12.0	3 10047	10.48	18.4	3.09081	15.77
5.8	3.11004	6.90	12.2	3.10017	10.62	18.6	3.09051	15.97
6.0	3.10973	7.00	12.4	3.09986	10.76	18.8	3.09021	16.17
6.2	3.10942	7.09	12.6	3.09956	10.90	19.0	3.08992	16.37

REDUCTION OF GAS. VOLUMES TO 0° AND 760 MM.—Con.

°C.	LOGARITHM OF $\frac{1}{760\,(1+0.00367t)}$	TENSION AQUEOUS VAPOR	°C.	LOGARITHM OF $\frac{1}{760\,(1+0.00367t)}$	TENSION AQUEOUS VAPOR	°C.	LOGARITHM OF $\frac{1}{760\,(1+0.00367t)}$	TENSION AQUEOUS VAPOR
		mm.			*mm.*			*mm.*
19.2	3.08962	16.57	24.6	3.08165	22.99	30.0	3.07383	31.56
19.4	3.08932	16.78	24.8	3.08136	23.27	30.2	3.07354	31.92
19.6	3.08902	16.98	25.0	3.08107	23.55	30.4	3.07325	32.29
19.8	3.08873	17.19	25.2	3.08078	23.83	30.6	3.07297	32.66
20.0	3.08843	17.41	25.4	3.08048	24.11	30.8	3.07268	33.04
20.2	3.08813	17.62	25.6	3.08019	24.40	31.0	3.07239	33.42
20.4	3.08783	17.84	25.8	3.07990	24.69	31.2	3.07211	33.80
20.6	3.08754	18.06	26.0	3.07961	24.99	31.4	3.07182	34.19
20.8	3.08724	18.28	26.2	3.07932	25.28	31.6	3.07154	34.58
21.0	3.08695	18.50	26.4	3.07903	25.58	31.8	3.07125	34.97
21.2	3.08665	18.73	26.6	3.07874	25.89	32.0	3.07097	35.37
21.4	3.08635	18.96	26.8	3.07844	26.19	32.2	3.07068	35.77
21.6	3.08606	19.19	27.0	3.07816	26.50	32.4	3.07039	36.18
21.8	3.08576	19.42	27.2	3.07787	26.82	32.6	3.07011	36.59
22.0	3.08547	19.66	27.4	3.07758	27.13	32.8	3.06983	37.01
22.2	3.08517	19.90	27.6	3.07729	27.45	33.0	3.06954	37.43
22.4	3.08488	20.14	27.8	3.07700	27.78	33.2	3.06926	37.85
22.6	3.08458	20.39	28.0	3.07671	28.10	33.4	3.06897	38.28
22.8	3.08429	20.63	28.2	3.07642	28.43	33.6	3.06869	38.71
23.0	3.08400	20.88	28.4	3.07613	28.77	33.8	3.06841	39.15
23.2	3.08370	21.14	28.6	3.07584	29.10	34.0	3.06812	39.59
23.4	3.08341	21.39	28.8	3.07555	29.44	34.2	3.06784	40.03
23.6	3.08312	21.65	29.0	3.07527	29.78	34.4	3.06756	40.48
23.8	3.08282	21.91	29.2	3.07498	30.13	44.6	3.06727	40.93
24.0	3.08253	22.18	29.4	3.07469	30.48	34.8	3.06699	41.39
24.2	3.08224	22.45	29.6	3.07440	30.84	35.0	3.06671	41.85
24.4	3.08194	22.72	29.8	3.07411	31.19			

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

A — WEIGHED OR FOUND	B — REQUIRED	A Factor	A Logarithm	B Factor	B Logarithm
Aluminum, Al 27.1					
Al_2O_3	Al	0.53033	1.72455	1.8856	0.27545
	K_2SO_4. $Al_2(SO_4)_3$. $24H_2O$	9.28650	0.96785	0.10768	1.03215
Ammonium, NH_4 18.04					
HCl	NH_4Cl	1.46690	0.16641	0.68169	1.83359
N	NH_3	1.21530	0.08477	0.82268	1.91523
	NH_4Cl	3.81870	0.58191	0.26187	9.41809
	$(NH_4)_2SO_4$	4.71620	0.67359	0.21203	1.32641
$(NH_4)_2PtCl_6$	NH_3	0.07673	2.88501	13.0320	1.11499
Antimony, Sb 120.2					
Sb	Sb_2O_3	1.19970	0.07907	0.83355	1.92093
	Sb_2O_5	1.33280	0.12476	0.75031	1.87524
Sb_2S_3	Sb	0.71419	1.85381	1.40010	0.14619
	Sb_2O_3	0.85680	1.93288	1.16720	0.06712
	Sb_2O_5	0.95185	1.97857	1.05060	0.02143
Arsenic, As 75					
As_2O_3	As	0.75756	1.87942	1.32000	0.12058
	As_2O_5	1.16162	0.06506	0.86088	1.93494
As_2O_5	As	0.65230	1.81438	1.53330	0.18562
As_2O_3	As	0.60923	1.78478	1.64140	0.21522
	As_2O_3	0.80419	1.90536	1.24350	0.09464
$Mg_2As_2O_7$	As	0.48287	1.68383	2.07090	0.31617
	As_2O_3	0.63739	1.80441	1.56890	0.19559
	As_2S_3	0.79259	1.89905	1.26160	0.10095
Barium, Ba 137 37					
$BaCO_3$	Ba	0.69611	1.84261	1.43680	0.15739
	$BaCl_2$	1.05510	0.02339	0.94757	1.97661
$BaCrO_4$	Ba	0.54195	1.73396	1.84750	0.26604
$BaSO_4$	Ba	0.58851	1.76975	1.70100	0.23025
	$BaCl_2$	0.89234	1.95054	1.12070	0.04947
	$BaCl_2 2H_2O$	1.04660	0.01982	0.95539	1 98018
	$BaCO_3$	0.84555	1.92714	1.18270	0.07286
	$Ba(NO_3)_2$	1.19180	0.04915	0.89299	1.95085
	BaO	0.65705	1.81760	1.52190	0 18240
CO_2	$BaCO_3$	4.48570	0.65183	0.22293	1.34817
Bismuth, Bi 208.0					
Bi	Bi_2O_3	1.11540	0.04743	0.89654	1.95257
BiOCl	Bi	0.80166	1.90399	1.24740	0.09601
Bromine, Br 79.92					
Ag	Br	0.74083	1.86972	1.34980	0.13028
	HBr	0.75053	1.87537	1.33240	0.12463
AgBr	Br	0.42556	1.62896	2.34980	0.37104
	HBr	0.43113	1.63461	2.31950	0.36539
Cadmium, Cd 112.4					
CdS	Cd	0.77802	1.89099	1.28530	0.10901
	$CdCl_2$	1.26870	0.10338	0.78817	1.89662
	$Cd(NO_3)_2$	1.63640	0.21391	0.61107	1.78609

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—Con.

A: WEIGHED OR FOUND	REQUIRED	A		B	
B: REQUIRED	WEIGHED OR FOUND	Factor	Logarithm	Factor	Logarithm
Calcium, Ca=40.09					
$BaSO_4$	$CaSO_4$	0.58332	1.76591	1.71440	0.23409
	$CaSO_4 2H_2O$	0.73758	1.86787	1.35560	0 13213
$CaCO_3$	Ca	0.40055	1.60265	2.49660	0.39735
	$CaCl_2$	1.10900	0.04493	0.90172	1.95507
	CaO	0 56040	1.74850	1.78440	0.25150
	$CaSO_4$	1.36040	0.13366	0.73509	1.86634
	$CaSO_4 2H_2O$	1.72040	0.23562	0.58128	1.76438
CaO	Ca	0.71474	1.85415	1.39910	0.14585
	$CaCl_2$	1.97890	0.29643	0.50532	1.70357
	$CaCO_3$	1.78440	0.25150	0.56040	1.74850
	$CaSO_4$	2 42750	0.38516	0.41195	1.61484
	$CaSO_4 2H_2O$	3 06980	0.48712	0.32575	1.51288
$CaSO_4$	Ca	0.29443	1.46899	3.39640	0.53101
	$CaCl_2$	0.81521	1 91127	1.22669	0.08873
	$CaCO_3$	0.73509	1.86634	1.36040	0.13366
	CaF_2	0 57353	1.75855	1.74360	0 24145
	CaO	0.41195	1.61484	2.42750	0.38516
	$CaCO_3$	2.27480	0.35694	0.43960	1.64306
Carbon, C=12.00					
CO_2	$BaCO_3$	4.48570	0.65183	0.22293	1.34817
	C	0.27273	1.43573	3.66676	0.56427
	$CaCO_3$	2.27480	0.35694	0.43960	0.64306
	K_2CO_3	3.14090	0.49706	0.31838	1.50294
	$KHCO_3$	2.27520	0.35702	0.43952	1.64298
	K_2O	2.14090	0.33060	0.46709	1.66940
	$MgCO_3$	1.91640	0.28248	0 52182	1.71752
	MgO	0.91637	1.96207	1.09130	0.03793
	$MnCO_3$	2.61210	0.41698	0.38284	1.58302
Carbon, CO_2	Na_2CO_3	2.40910	0.38186	0.41509	1.61814
	$NaHCO_3$	1.90930	0.28087	0.52376	1.71913
	Na_2O	1.40910	0.14894	0.70968	1.85106
	$(NH_4)_2CO_3$	2.18360	0.33918	0.45795	1.66082
	Pb_3CO_3	6.07050	0.78322	0.16473	1.21678
Chlorine, Cl=35.46					
Ag	Cl	0.32870	1.51680	3.04230	0.48320
	HCl	0 33796	1.52886	2.95900	0.47114
AgCl	Cl	0.24738	1.39337	4.04230	0.60663
Na	Cl	1.54170	0.18801	0.64862	1.81199
NaCl	Cl	0.60657	1.78288	1.64860	0.21712
NH_4	Cl	1.96560	0.29350	0.50874	1.70650
Chromium, Cr=52.1					
$BaCrO_4$	Cr	0.20554	1.31291	4.86510	0.68709
	Cr_2O_3	0.30022	1.47745	3.33080	0.52255
	CrO_3	0.39491	1.59650	2.53220	0.40350
Cr_2O_3	Cr	0.68463	1.83546	1.46063	0.16454
$PbCrO_4$	Cr	0.16121	1.20737	6.20340	0.79263
	Cr_2O_3	0.23546	1.37191	4.24711	0.62809
Copper, Cu=63.57					
Cu	CuO	1.25170	0.09750	0.79891	1.90250
Cu	$CuSO_4 5H_2O$	3.92830	0.59420	0.25457	1.40580
CuO	Cu	0.79891	1.90250	1.25170	0.09750
	$CuSO_4 5H_2O$	3.13830	0.49670	0.31864	1.50330

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—Con.

A	WEIGHED OR FOUND	REQUIRED	A		B	
B	REQUIRED	WEIGHED OR FOUND	Factor	Logarithm	Factor	Logarithm
Erbium, Er=167.4						
Fluorine, F=19						
CaF_2	F		0.48661	1.68718	2.05500	0.31282
	HF		0.51244	1.70964	1.95150	0.29036
	H_2SiF_6		1.84810	0.26672	0.54110	1.73328
Gold, Au=197.2						
Au	$AuCl_3$		1.53940	0.18736	0.64595	1.81264
Hydrogen, H=1.008						
H_2O	H		0.11190	1.04884	8.93630	0.95116
Iodine, I=126.92						
AgI	HI		0.54484	1.73627	1.83540	0.26372
	I		0.54055	1.73283	1.85000	0.26717
Iron, Fe=55.85						
Fe	FeO		1.28650	0.10941	0.77730	1.89059
	Fe_2O_3		1.42980	0.15525	0.69944	1.84475
	$FeSO_4$		2.72020	0.43460	0.36762	1.56540
	$FeSO_4 7H_2O$		4.97820	0.69707	0.20087	1.30293
	$FeSO_4(NH_4)_2SO_4 6H_2O$		7.02200	0.84646	0.14241	1.15354
Fe_2O_3	Fe		0.69944	1.84475	1.42980	0.15525
	FeCl		2.03170	0.30786	0.49222	1.69214
	$Fe(HCO_3)_2$		2.22760	0.34783	0.44892	1.65217
	FeO		0.89982	1.95416	1.11130	0.04584
	Fe_3O_4		0.96657	1.98523	1.03460	0.01477
	$FeSO_4$		1.90260	0.27935	0.52559	1.72065
	$FeSO_4 7H_2O$		3.48200	0.54182	0.28719	1.45818
	$FeSO_4(NH_4)_2SO_4 6H_2O$		4.91140	0.69121	0.20360	1.30879
	$Fe_2(SO_4)_3$		2.50420	0.39867	0.39933	1.60133
	$FePO_4$		1.88920	0.27627	0.52934	1.72373
FeS	Fe		0.63522	1.80293	1.57430	0.19707
	FeO		0.81723	1.91234	1.22370	0.08766
	Fe_2O_3		0.90820	1.95818	1.10110	0.04182
	$FeSO_4$		1.89730	0.27815	0.52705	1.72185
Lead, Pb=207.1						
Pb	PbO		1.07720	0.03232	0.92828	1.96768
	$PbCO_3$		1.28970	0.11049	0.77537	1.88951
	$(PbCO_3)_2Pb(OH)_2$		1.24790	0.09618	0.80135	1.90382
$PbCl_2$	Pb		0.74492	1.87211	1.34240	0.12789
	PbO		0.80248	1.90443	1.24610	0.09557
$PbCrO_4$	Pb		0.64078	1.80671	1.56060	0.19329
	$Pb(C_2H_3O_2)_2 3H_2O$		1.17330	0.06940	0.85231	1.93060
	$(PbCO_3)_2Pb(OH)_2$		0.79964	1.90289	1.25050	0.09711
	PbO		0.69029	1.83303	1.44860	0.16097
	Pb_3O_4		0.70679	1.84929	1.41480	0.15071
	$PbSO_4$		0.93803	1.97222	1.06610	0.02778
$PbSO_4$	$BaSO_4$		0.76998	1.88648	1.29880	0.11352

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—Con.

A: WEIGHED OR FOUND	REQUIRED	A		B	
B: REQUIRED	WEIGHED OR FOUND	Factor	Logarithm	Factor	Logarithm
Lead, Pb=207.1					
$PbSO_4$	Pb	0.68311	1.83449	1.46390	0.16551
	$Pb(C_2H_3O_2)_2 3H_2O$	1.25070	0.09718	0.79947	1.90282
	$PbCO_3$	0.88101	1.94498	1.13510	0.05502
	$(PbCO_3)_2 Pb(OH)_2$	0.85245	1.93067	1.17310	0.06933
	Pb_3O_4	0.75348	1.87707	1.32720	0.12293
PbS	Pb	0.86591	1.93747	1.15490	0.06253
	$PbSO_4$	1.26760	0.10298	0.78890	1.89702
Magnesium, Mg=24.32					
$BaSO_4$	$MgSO_4$	0.51576	1.71245	1.93890	0.28755
	$MgSO_4 7H_2O$	1.05600	0.02368	0.94693	1.97632
Co_2	$MgCO_3$	1.91640	0.28248	0.52182	1.71752
	MgO	0.91637	1.96207	1.09130	0.03793
Mg	$MgCO_3$	3.46720	0.53997	0.28842	1.46003
MgO	Mg	0.60317	1.78044	1.65790	0.21956
	$MgCO_3$	2.09120	0.32041	0.47818	1.67959
	$MgSO_4$	2.98590	0.47507	0.33491	1.52493
$Mg_2P_2O_7$	Mg	0.21846	1.33938	4.57740	0.66062
	$MgCO_3$	0.75745	1.87935	1.32030	0.12065
	MgO	0.36219	1.55894	2.76100	0.44106
Manganese, Mn=54.93					
Mn	MnO	1.29130	0.11102	0.77442	1.88898
	Mn_2O_3	1.43690	0.15744	0.69593	1.84256
	Mn	0.72026	1.85749	1.38840	0.14251
	Mn_2O_3	1.03490	0.01492	0.96623	1.98508
	MnO_2	1.13980	0.05685	0.87730	1.94315
$Mn_2P_2O_7$	Mn	0.38703	1.58774	2.5839	0.41226
	MnO_2	0.61249	1.78710	1.6327	0.21290
Mercury, Hg=200					
Hg	$HgCl_2$	1.35460	0.13181	0.72822	1.86819
	HgO	1.07990	0.03342	0.92593	1.96658
	HgS	1.16030	0.06459	0.96181	1.93541
HgS	$HgCl_2$	1.16740	0.06722	0.85661	1.93278
Nickel, Ni=58.68					
Ni	NiO	1.27260	0.10471	0.78576	1.89529
Nitrogen, N=14.01					
KNO_3	N_2O_5	0.53417	1.72768	1.87210	0.27232
N	HNO_3	4.49820	0.65304	0.22231	1.34696
	NO_2	3.28410	0.51641	0.30450	1.48359
	N_2O_3	2.71310	0.43346	0.36858	1.56654
	NO_3	4.42810	0.64602	0.22593	1.35398
	N_2O_5	3.85510	0.58603	0.25940	1.41397
Phosphorus, P=31.0					
	P	0.27847	1.44478	3.59110	0.55522
	P_2O_5	0.63780	1.80468	1.56790	0.19532
$(NH_4)_3PO_4 (MoO_3)_{12}$	P	0.01651	2.21787	60.5520	1.78213
	P_2O_5	0.03782	2.57777	26.4380	1.42223
	P	0.43662	1.64010	2.29030	0.35990

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—Con.

A: WEIGHED OR FOUND / B: REQUIRED	REQUIRED: WEIGHED OR FOUND	A: Factor	A: Logarithm	B: Factor	B: Logarithm
Platinum, Pt=195.0					
K_2PtCl_6	Pt	0.40127	1.60343	2.49210	0.39657
Potassium, K=39.10					
AgI	KI	0.70707	1.84946	1.41430	0.15054
	KCl	2.10260	0.32277	0.47558	1.67723
I	KI	1.30810	0.11663	0.76448	1.88337
	K_2CO_3	0.92677	1.96697	1.07900	0.03303
	$K_2Cr_2O_7$	1.97420	0.29540	0.50652	1.70460
	KNO_3	1.35600	0.13228	0.73742	1.86772
	K_2O	0.63169	1.80051	1.58300	0.19949
	K_2SO_4	1.16860	0.06768	0.85570	1.93232
KOH	K_2CO_3	1.23150	0.09044	0.81201	1.90956
	K_2O	0.83942	1.92398	1.19130	0.07602
K_2O	K	0.83015	1.91916	1.20460	0.08084
	K_2CO_3	1.46710	0.16646	0.68161	1.83354
	$K_2Cr_2O_7$	3.12520	0.49489	0.31997	1.50511
	K_2SO_4	1.85000	0.26717	0.54055	1.73283
K_2PtCl_6	K	0.16092	1.20661	6.21430	0.79339
	K_2CO_3	0.28439	1.45391	3.51630	0.54609
	KCl	0.30686	1.48694	3.25890	0.51306
	K_2O	0.19384	1.28745	5.15880	0.71255
	$K_2SO_4Al_2(SO_4)_3 24H_2O$	1.95300	0.29070	0.51204	1.70930
Silicon, Si=28.3					
SiO_2	H_2SiO_3	1.29880	0.11355	0.76993	1.88645
	Si	0.46933	1.67147	2.13070	0.32853
	SiF_4	1.72960	0.23796	0.57815	1.76204
Silver, Ag=107.88					
Ag	$AgNO_3$	1.57480	0.19723	0.63499	1.80277
AgBr	Ag	0.57443	1.75924	1.74080	0.24076
AgCl	Ag	0.75261	1.87657	1.32870	0.12343
Sodium, Na=23.00					
Cl	Na	0.64862	1.81199	1.54170	0.18801
	NaCl	1.64860	0.21712	0.60657	1.78288
	Na_2O	0.87422	1.94162	1.14390	0.05838
CO_2	Na_2CO_3	2.40910	0.38186	0.41509	1.61814
H_3BO_3	$Na_2B_4O_7$	0.81420	1.91073	1.22820	0.08927
	$Na_2B_4O_7 10H_2O$	1.54040	0.18763	0.64918	1.81237
NaCl	Na	0.39343	1.59487	2.54180	0.40513
	Na_2CO_3	0.90661	1.95742	1.10300	0.04258
	$NaHCO_3$	1.43700	0.15746	0.69589	1.84254
	Na_2O	0.53028	1.72451	1.88580	0.27549
Na_2CO_3	Na	0.43396	1.63745	2.30440	0.36255
	$NaHCO_3$	1.58500	0.2004	0.63090	1.79996
	NaOH	0.75486	1.87787	1.32470	0.12213
$NaHCO_3$	Na	0.27379	1.43741	3.65250	0.56259
	Na_2O	0.36901	1.56704	2.71000	0.43296
Na_2SO_4	Na	0.32378	1.51026	3.08850	0.48974
	Na_2CO_3	0.74613	1.87281	1.34030	0.12719
	$Na_2CO_3 10H_2O$	2.01420	0.30411	0.40646	1.69589
	Na_2O	0.43640	1.63989	2.29150	0.36011

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—Con.

A: WEIGHED OR FOUND	REQUIRED	A		B	
B: REQUIRED	WEIGHED OR FOUND	Factor	Logarithm	Factor	Logarithm
Sodium, Na=23.00					
SO_3	Na_2O	0.77432	1.88892	1.29140	0.11108
	Na_2SO_4	1.77430	0.24903	0.56360	1.75097
Sulphur, S=32.07					
$BaSO_4$	H_2S	0.14604	1.16446	6.84760	0.83554
	H_2SO_3	0.35166	1.54612	2.84370	0.45388
	H_2SO_4	0.42020	1.62345	2.37990	0.37655
	S	0.13738	1.13793	7.27900	0.86207
	SO_2	0.27446	1.43848	3.64350	0.56152
	SO_3	0.34300	1.53530	2.91540	0.46470
	SO_4	0.41155	1.61442	2.42980	0.38558
Tin, Sn=119.0					
Sn	SnCl	1.59600	0.20303	0.62657	1.79697
	$SnCl_2H_2O$	1.89880	0.27847	0.52666	1.72153
	$SnCl_4$	2.19200	0.34083	0.45621	1.65917
	SnO	1.13440	0.05478	0.88149	1.94522
	SnO_2	1.26891	0.10343	0.78808	1.89657
SnO_2	Sn	0.78808	1.89657	1.26891	0.10343
	$SnCl_2$	1.25780	0.09960	0.79506	1.90040
	$SnCl_22H_2O$	1.49630	0.17504	0.66828	1.82496
	$SnCl_4$	1.72740	0.23740	0.57890	1.76260
	$SnCl_4$ $(NH_4Cl)_2$	2.43600	0.38668	0.41051	1.61332
	SnO	0.89402	1.95135	1.11854	0.04865
Titanium, Tl=48.1					
TlO	Tl	0.60051	1.77852	1.66520	0.22148
Tungsten, W=184					
WO_3	W	0.79310	1.89933	1.26090	0.10067
Zinc, Zn=65.37					
Zn	ZnO	1.24470	0.09508	0.80338	1.90492
ZnO	$ZnCO_3$	1.54070	0.18773	0.64903	1.81227
	ZnCl	1.67490	0.22401	0.59702	1.77599
	$ZnSO_47H_2O$	3.53400	0.54826	0.28297	1.45174
$Zn_2P_2O_7$	Zn	0.42902	1.63249	2.33090	0.36752
	ZnO	0.55402	1.72756	1.87260	0.27244
ZnS	Zn	0.67087	1.82664	1.49060	0.17336
	ZnO	0.83507	1.92172	1.19759	0.07828

SPECIFIC GRAVITY OF GASES

NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY, AIR = 1		WEIGHT IN GRAMS OF 1 LITER AT 0° 760 MM. AT SEA LEVEL, LAT. 45°
			Calculated	Observed	
Acetylene	C_2H_2	26.016	0.8988	0.92	1.1620
Air			1.0000		1.2926
Ammonia	NH_3	17.034	0.5895	0.5963	0.7708
Argon	A	39.9	1.379	1.3778	1.7828
Arsine	AsH_3	78.024	2.696	2.695	3.485
Bromine	Br_2	159.84	5.5249	5.524 (227.9°)	7.1426
Butane	C_4H_{10}	58.08	2.0065	2.01	2.594
Carbon dioxide	CO_2	44.00	1.5201	1.52932	1.9768
Carbon Monoxide	CO	28.00	0.9673	0.96735	1.2504
Carbon oxysulphide	COS	60.07	2.0749	2.1046	2.6825
Chlorine	Cl_2	70.92	2.489	2.491	3.1666
Cyanogen	C_2N_2	52.08	1.7993	1.8064	2.3261
Ethane	C_2H_6	30.048	1.0381	1.075	1.3421
Ethylene	C_2H_4	28.032	0.9784	0.9852	1.2520
Fluorine	F_2	38.0	1.313	1.26	1.697
Helium	He	4.0	0.1382	0.1368	0.1787
Hydrobromic acid	HBr	80.928	2.7973	2.71	3.6163
Hydrochloric acid	HCl	36.468	1.2595	1.2686	1.6398
Hydrofluoric acid	HF	20.008	0.691	0.7126	0.894
Hydroiodic acid	HI	127.93	4.4172	4.3757	5.7106
Hydrogen	H_2	2.016	0.06965	0.06953	0 089873
Hydrogen selenide	H_2Se	81.216	2.806	2.795	3.627
Hydrogen sulphide	H_2S	34.086	1.1773	1.1895	1.5230
Hydrogen telluride	H_2Te	129.52	4.478	4.489	5.789
Krypton	Kr	81.8	2.826	2.818	3.654
Methane	CH_4	16.032	0.5539	0.5576	0.7160
Neon	Ne	20.00	0.691	0.674	0.893
Nitric oxide	NO	30.01	1 0378	1.0368	1.3402
Nitrous oxide	N_2O	44.02	1.5229	1.5300	1.9777
Nitrogen	N_2	28.02	0.9701	0.96758	1.2507
atmospheric	N_2+A etc.			0.97209	1.25718
Nitrogen dioxide	NO_2	46.01	1.5906	1.60 (135°)	2.0563
Nitrogen dioxide	N_2O_4	92.02	3.1812	2.65 (26.7°)	4.1126
Nitrosyl chloride	NOCl	65.47	2.2625	2.31	2.925
Oxygen	O_2	32.00	1.1055	1.1055	1.4290
Phosphine	PH_3	34.024	1.175	1.214	1.520
Propylene	C_3H_6	42.048	1.4527	1.498	1.8780
Silicon fluoride	SiF_4	104.4	3.607	3.60	4.663
Sulphur dioxide	SO_2	64.06	2.2131	2.2641	2.9266
Xenon	X	128.00	4.422	4.422	5.717

HEATS OF FORMATION AND HEATS OF SOLUTION

The unit is the large calorie = 1000 common calories. The negative sign signifies that heat is absorbed during the formation of the compound.

COMPOUND	CHEMICAL SYMBOL	HEAT OF FORMATION	HEAT OF SOLUTION
Ozone	O_3	−34.1[1]	
Water, vapor	H_2O	58.7	
Water, liquid	H_2O	68.4	
Hydrogen dioxide	H_2O_2	45.2	
Hydrochloric acid	HCl	22.0	20.3
Hydrobromic acid (gaseous bromine)	HBr	12.1	19.9
Hydriodic acid (solid iodine)	HI	−6.1	19.2
Hydrogen sulphide	H_2S	2.7	4.6
Sulphuric acid	H_2SO_4	193.1	17.8
Ammonia	NH_3	12.0	8.4
Nitric acid	HNO_3	41.9	7.2
Nitrous oxide	N_2O	−18.0	
Nitric oxide	NO	−21.6	
Nitrogen peroxide	N_2O_4	− 2.6	
	NO_2	− 7.7	
Nitrogen pentoxide	N_2O_5	13.1	
Phosphoric acid	H_3PO_4	302.9	2.7
Carbon dioxide (from amorphous carbon)	CO_2	97.6	6.0
Carbon monoxide	CO	29.0	
Methane	CH_4	22.4	
Carbon tetrachloride	CCl_4	21.6	
Carbon bisulphide	CS_2	−19.0	
Hydrocyanic acid	HCN	−27.6	
Potassium hydroxide	KOH	103.2	13.3
Potassium chloride	KCl	104.3	− 3.1
Potassium chlorate	$KClO_3$	95.9	
Potassium perchlorate	$KClO_4$	113.1	−12.1
Potassium bromide	KBr	95.1	− 5.1
Potassium iodide	KI	80.1	− 5.1
Potassium sulphate	K_2SO_4	344.6	− 6.4
Potassium nitrate	KNO_3	119.5	− 8.5
Potassium sulphide	K_2S	101.2	10.0
Potassium carbonate	K_2CO_3	281.1	− 6.5
Potassium permanganate	$KMnO_4$	195.0	−10.4
Sodium hydroxide	NaOH	101.9	10.9
Sodium chloride	NaCl	97.6	1.2
Sodium bromide	NaBr	85.8	− 0.2
Sodium sulphide	Na_2S	87.0	15.0
Sodium hyposulphite	$Na_2S_2O_3$		
	5aq	265.2	−11.4
Sodium sulphite	Na_2SO_3	268.5	−11.1

HEATS OF FORMATION AND HEATS OF SOLUTION—Continued

COMPOUND	CHEMICAL SYMBOL	HEAT OF FORMATION	HEAT OF SOLUTION
Sodium sulphate	Na_2SO_4	328.8	0.2
Sodium nitrate	$NaNO_3$	111.3	−5.0
Sodium carbonate	Na_2CO_3	272.6	5.60
Ammonium chloride	NH_4Cl	75.8	−4.0
Ammonium sulphate	$(NH_4)_2SO_4$	282.2	−2.6
Ammonium nitrate	NH_4NO_3	88.0	−6.2
Calcium hydroxide	$Ca(OH)_2$	215.0	3.0
Calcium oxide	CaO	131.0	(Heat of hydration =15.5)
Calcium chloride	$CaCl_2$	170.0	17.4
Calcium carbonate	$CaCO_3$	270.0	
Magnesium hydroxide	$Mg(OH)_2$	217.3	
Magnesium sulphate	$MgSO_4$	502.0	20.3
Aluminum hydroxide	$Al(OH)_3$	297.0	
Manganese hydroxide	$Mn(OH)_2$	163.0	
Ferrous hydroxide	$Fe(OH)_2$	136.7	
Ferrous chloride	$FeCl_2$	82.0	17.9
Ferrous sulphate	$FeSO_4 \cdot aq$	235.6	
Ferric hydroxide	$Fe(OH)_3$	198.0	
Ferric chloride	$FeCl_3$	96.1	63.3
Cobalt hydroxide	$Co(OH)_2$	131.8	
Cobalt chloride	$CoCl_2$	76.5	18.3
Nickel hydroxide	$Ni(OH)_2$	129.2	
Nickel chloride	$NiCl_2$	74.5	19.2
Zinc oxide	ZnO	85.8	
Zinc chloride	$ZnCl_2$	97.0	15.6
Zinc sulphide	$ZnS \cdot aq$	39.6	
Zinc sulphate	$ZnSO_4$	230.0	18.5
Cadmium hydroxide	$Cd(OH)_2$	134.1	
Cadmium chloride	$CdCl_2$	93.2	3.0
Cupric oxide	CuO	37.2	
Cupric chloride	$CuCl_2$	51.6	11.1
Cupric sulphate	$CuSO_4$	182.6	15.8
Cupric nitrate	$Cu(NO_3)_2 \cdot aq$	82.3	
Cuprous oxide	Cu_2O	40.8	
Cuprous chloride	Cu_2Cl_2	65.7	
Mercurous oxide	Hg_2O	22.2	
Mercurous chloride	Hg_2Cl_2	62.6	
Mercuric oxide	HgO	20.7	
Mercuric chloride	$HgCl_2$	53.2	−3.3
Potassium amalgam	KHg_{12}	34.0	
Sodium amalgam	$NaHg_6$	21.1	
Silver oxide	Ag_2O	5.9	

BASICITY OF ACIDS WITH VARIOUS INDICATORS ACCORDING TO R. T. THOMPSON

The numbers indicate in each case the number of molecules of a univalent base, such as caustic soda, which will have combined with one molecule of the acid when the solution reacts neutral to the indicator given. Thompson divided indicators into three classes. Methyl orange is typical of the first class which also includes lacmoid, dimethyl amidobenzene, cochineal, iodeosine and congo red. Phenolphthalein is typical of the second class which includes turmeric, curcuma and flavescin. Litmus is typical of the third class, which includes rosolic acid, phenacetolin, fluorescein, gallein, and hematoxylin.

ACIDS		METHYL ORANGE	PHENOL-PHTHALEIN		LITMUS	
Name	Formula	Cold	Cold	Boiling	Cold	Boiling
Sulphuric	H_2SO_4	2	2	2	2	2
Hydrochloric	HCl	1	1	1	1	1
Nitric	HNO_3	1	1	1	1	1
Thiosulphuric	$H_2S_2O_3$	2	2	2	2	2
Carbonic	H_2CO_3	0	1	0		0
			dilute			
Sulphurous	H_2SO_3	1	2			
Hydrosulphuric	H_2S	0	1	0		0
			dilute			
Phosphoric	H_3PO_4	1	2			
Arsenic	H_3AsO_4	1	2			
Arsenous	H_3AsO_3	0			0	0
Nitrous	HNO_2		1		1	
Silicic	H_4SiO_4	0			0	0
Boric	H_3BO_3	0				
Chromic	H_2CrO_4	1	2	2		
Oxalic	$H_2C_2O_4$		2	2	2	2
Acetic	$HC_2H_3O_2$		1		1 nearly	
Butyric	$HC_4H_7O_2$		1		1 nearly	
Succinic	$H_2C_4H_4O_4$		2		2 nearly	
Lactic	$HC_3H_5O_3$		1		1	
Tartaric	$H_2C_4H_4O_6$		2		2	
Citric	$H_3C_6H_5O_7$		3			

A FOUR PLACE LOGARITHM TABLE

Logarithms of numbers from 1 to 1000

NO.	0	1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428
35	5441	5453	5465	5478	5490	5502	5515	5527	5539	5551
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981

A FOUR PLACE LOGARITHM TABLE.—Continued

NO.	0	1	2	3	4	5	6	7	8	9
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538

A FOUR PLACE LOGARITHM.—Continued

NO.	0	1	2	3	4	5	6	7	8	9
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996

PREPARATION AND PROPER CONCENTRATION OF LABORATORY REAGENTS FOR GENERAL USE

Dilute Acids of 5N Strength.—Sulphuric acid, 5N. One volume strong acid to 6 volumes water.

Nitric acid, 5N. One volume strong acid to 2 volumes water.

Hydrochloric acid, 5N. Five volumes strong acid to 8 volumes water.

Acetic acid, 5N. One volume strong acid to 2½ volumes water.

Dilute Bases of 5N Strength.—Potassium hydroxide, 5N. 280 grams per liter of solution with water.

Sodium hydroxide, 5N. 200 grams per liter of solution with water.

Ammonium hydroxide, 5N. One volume strong ammonia (sp. gr. 90) to 2 vol. water.

Other Reagents of 5N Strength.—Ammonium sulphide, 5N. 600 cc. 5N ammonium hydroxide is saturated with hydrogen sulphide. Dilute to one liter with 5N ammonium hydroxide.

Sodium sulphide, 5N. Dissolve 200 grams sodium hydroxide in 800 cc. water. Saturate 400 cc. of this solution with hydrogen sulphide. Add the remaining 400 cc. of sodium hydroxide and dilute the whole to one liter.

Ammonium chloride, 5N. 267.5 grams per liter of solution with water.

Ammonium carbonate, 5N. 200 grams solid salt dissolved in 350 cc. 5N ammonium hydroxide and dilute with water to 1 liter.

Ammonium acetate 5N. Dilute 300 cc. strong acetic acid with 300 cc. water and neutralize with strong ammonia. Dilute to 1 liter.

Reagents of N Strength.—Sodium acetate, 136.14 grams per liter with water.

Sodium phosphate, 119.45 grams per liter with water.

Calcium chloride, 109.51 grams per liter with water.

Magnesium sulphate, 123.28 grams per liter with water.

Barium chloride, 122.17 grams per liter with water.

Ferric chloride, 54.11 grams per liter with water and add sufficient HCl to keep in solution.

Potassium ferrocyanide, 105.72 grams per liter with water.

Lead acetate, 189.51 grams per liter with water.

Stannous chloride, 112.72 grams of the solid salt plus 200 cc. 5N HCl diluted to one liter with water. Add metallic tin to the solution in the bottle to keep it from oxidizing.

Mercurous nitrate, 262.34 grams per liter with water. Add sufficient nitric acid to keep solution clear and put metallic mercury in the bottle to prevent oxidization.

Cobalt nitrate, 145 grams per liter with water.

Reagents of N/2 Strength.—Ammonium oxalate, 35.5 grams per liter with water.

Mercuric chloride, 67.8 grams per liter with water.

Zinc sulphate, 71.9 grams per liter with water.

Manganese sulphate, 55.78 grams per liter with water.

Nickel sulphate, 70.22 grams per liter with water.

Cadmium sulphate, 64.05 grams per liter with water.

Copper sulphate, 62.4 grams per liter with water.

Miscellaneous Reagents.—Aqua regia, mix 1 part HNO_3 with three parts of concentrated HCl.

Silver nitrate N/10, 17 grams per liter with water.

Magnesia mixture N, dissolve 68 grams crystallized $MgCl_2$ and 165 grams NH_4Cl in 300 cc. water. Add 300 cc. 5N ammonium hydroxide and dilute to one liter.

Molybdate solution, dissolve 60 grams molybdic oxide (MoO_3) in 440 cc. of water and 60 cc. strong ammonia (sp. gr. 90). Pour into 500 cc. of cold nitric acid which has been diluted 250 cc. concentrated acid to 250 cc. water. Let stand in a warm place several days. Decant or filter before using.

Phenolsulphonic acid, dissolve 150 grams of phenol in 600 grams of concentrated sulphuric acid.

Yellow ammonium sulphide, 50 to 75 grams of sulphur to a liter of colorless ammonium sulphide.

Ferrous sulphate, dissolve 200 grams $FeSO_4.7H_2O$ in a liter of water. Place scraps of iron in the solution and add a few drops of H_2SO_4 from time to time.

MOLECULAR AND ATOMIC WEIGHTS AND THEIR LOGARITHMS

FORMULA	FORMULA WEIGHT		FORMULA	FORMULA WEIGHT	
	Number	Logarithm		Number	Logarithm
Ag	107.88	2.03304	$CaCO_3$	100.09	2.00039
AgBr	187.80	2.27370	CaF_2	78.09	1.89260
AgCl	143.34	2.15637	$Ca(NO_3)_2$	164.11	2.21514
AgI	234.80	2.37070	CaO	56.09	1.74889
AgNO	169.89	2.23017	$CaOCl_2$	127.00	2.10380
Ag_2O	231.76	2.36504	$Ca(OH)_2$	74.116	1.86992
Ag_3PO_4	418.64	2.62184	$Ca_3(PO_4)_2$	310.27	2.49174
Al	27.10	1.43297	CaS	72.16	1.85830
AlCl	133.48	2.12542	$CaSO_4$	136.16	2.13405
$AlK(SO_4)_212H_2O$	474.53	2.67627	$CaSO_42H_2O$	172.19	2.23601
$AlNH_4(SO_4)_2$	453.47	2.65655	$CaSiO_3$	116.39	2.06592
Al_2O_3	102.20	2.00945	Cd	112.40	2.05077
$AlPO_4$	122.10	2.08672	$CdCl_2$	183.32	2.26316
$Al_2(SO_4)_3$	342.41	2.53454	$CdCl_22H_2O$	219.33	2.34110
$Al_2(SO_4)_318H_2O$	666.70	2.82393	$CdCO_3$	172.40	2.23654
As	75.00	1.87506	$Cd(NO_3)_2$	236.42	2.37369
$AsCl_3$	181.38	2.25859	$Cd(NO_3)_24H_2O$	308.48	2.48922
As_2O_3	198.00	2.29667	CdO	128.40	2.10857
As_2O_5	230.00	2.36173	CdS	144.46	2.15978
As_2S_3	246.21	2.39131	$CdSO_4$	208.47	2.31905
As_2S_5	310 35	2.49185	Ce	140.25	2.14691
Au	197 20	2.29491	Co	58.97	1.77063
$AuCl_3$	303.58	2.48227	$CoCl_26H_2O$	238.00	2.37658
$AuCl_32H_2O$	339.61	2.53098	$Co(NO_3)_26H_2O$	291.09	2.46402
B	11.00	1.04139	$Co(NO_2)_3(KNO_2)_2$	452.33	2.65536
B_2O_3	70.00	1.84510	CoO	74.97	1.87489
Ba	137.37	2.13789	Co_3O_4	240.91	2.38186
$BaCl_2$	208.29	2.31867	$CoSO_4$	155.04	1.90440
$BaCl_22H_2O$	244.32	2.38796	$CoSO_47H_2O$	281.15	2.44894
$BaCO_3$	197.37	2.29528	Cr	52.10	1.71584
$BaCrO_4$	253.47	2.40393	Cr_2O_3	152.20	2.18241
$Ba(NO_3)$	261.39	2.41729	CrO_3	100.10	2.00043
BaO	153.37	2.18574	CrO_4	116.10	2.06483
$Ba(OH)_2$	171.386	2.23398	Cr_2O_7	216.20	2.33486
BaS	169.44	2.22901	$FeSO_47H_2O$	278.03	2.44409
$BaSO_4$	233.44	2.36814	$FeSO_4(NH_4)_2SO_4$ $6H_2O$	392.17	2.59348
Bi	208.00	2.31806	$Fe_2(SO_4)_3$	399.91	2.60196
Bi_2O_3	464.00	2.66652	H	1 008	0.00346
BiOCl	259.46	2.41407	H_2	2.016	0.30449
$BiONO_3$	286.01	2.45639	H_3AsO_3	126.024	2.10046
Bi_2S_3	512.21	2.70945	H_3AsO_4	142.02	2.15235
Br	79.92	1.90266	H_3BO_3	62.024	1.79256
C	12.00	1.07918	HBr	80.93	1.90811
CH_3	16.032	1.20498	$H_2C_2O_4$	90.016	1.95432
C_2H_2	26.016	1.41524	$H_2C_2O_42H_2O$	126.05	2.10054
C_2H_4	28.032	1.44765	$H.C_2H_3O_2$	60.032	1.77838
C_2H_6	30.048	1.477781	$H.C_3H_5O_3$	90.05	1.95447
C_4H_6	78.05	1.89237	$H_2.C_4H_4O_6$	150 05	2.17623
Cn	26.01	1.41514	$H_3.C_6H_5O_7$	192.06	2.28345
CNS	58.08	1.76403	HCl	36.47	1.56194
CO	28.00	1.44716	$HClO_3$	84.47	1.92670
CO_2	44.00	1.64345	HCN	27.02	1.43169
CS_2	76.14	1.88161	HCO_2	45.008	1.65329
Ca	40.09	1.60304	HF	20.008	1.30121
CaC_2	64.09	1.80679	HI	127.93	
$CaCl_2$	111.01	2.04532	K	39.10	1.59218
$CaCl_26H_2O$	219.11	2.34066	K_2	78.20	1.89321

MOLECULAR AND ATOMIC WEIGHTS AND THEIR LOGARITHMS—Con.

FORMULA	FORMULA WEIGHT		FORMULA	FORMULA WEIGHT	
	Number	Logarithm		Number	Logarithm
$KAl(SO_4)_2 12H_2O$	474.53	2.67627	$MnSO_4 H_2O$	223.06	2.34842
KBr	119.02	2.07562	$MnSO_4 7H_2O$	277.11	2.44266
$K_2C_4H_4O_6$	226.23	2.35455	Mo	96.00	1.98227
KCl	74.56	1.87251	MoO_3	144.00	2.15836
$KClO_3$	122.56	2.08835	MoS_2	192.21	2.28377
$KClO_4$	138.56	2.14164	N	14.01	1.14644
KCN	65.11	1.81365	N_2	28.02	1.44747
KCNS	97.18	1.98758	NH_3	17.03	1.23121
K_2CO_3	138.20	2.14051	$NH_4Al(SO_4)_2 12H_2O$	453.47	2.65655
K_2CrO_4	194.30	2.28847	NH_4Br	97.96	1.99109
$K_2Cr_2O_7$	294.40	2.46894	NH_4Cl	53.50	1.72835
$KCr(SO_4)_2 12H_2O$	499.53	2.69857	$(NH_4)_2C_2O_4 2H_2O$	160.11	2.20442
$K_3Fe(CN)_6$	329.21	2.51747	$NH_4Fe(SO_4)_2 12H_2O$	482.22	2.68325
$K_4Fe(CN)_6$	368.34	2.56625	$(NH_4)_2Fe(SO_4)_2$ $6H_2O$	392.17	2.59348
$K_4Fe(CN)_6 3H_2O$	422.36		$(NH_4)_2MoO_4$	196.08	2.29244
$KHC_4H_4O_6$	188.14	2.27448	NH_4NO_3	80.05	1.90336
$KHCO_3$	100.11	2.00047	$NH_4NaHPO_4 H_2O$	209.11	2.32037
$KHSO_4$	136.18	2.13411	NH_4OH	35.05	1.54469
KI	166.02	2.22016	$(NH_4)_3PO_4 12MoO_3$	1877.13	3.27349
KIO_3	214.02	2.33045	$(NH_4)_2PtCl_6$	443.84	2.64723
$KMnO_4$	158.03	2.19874	$(NH_4)_2SO_4$	132.15	2.12106
K_2MnO_4	197.13	2.29476	NH_4CNS	76.12	1.88150
KNO_2	85.13	1.93008	N_2O	44.02	1.64365
KNO_3	101.11	2.00479	NO	30.01	1.47727
$KNaC_4H_4O_6$	210.15	2.33253	NO_2	46.01	1.66285
K_2O	94.20	1.97405	N_2O_3	76.02	1.88093
KOH	56.11	1.74904	N_2O_5	92.01	1.79246
K_2PtCl_6	485.96	2.68660	NO_3	108.02	2.03350
K_2S	110.27	2.04256	Na	23.00	1.36173
K_2SO_4	174.27	2.24122	$Na_2B_4O_7$	202.00	2.30535
$KSbOC_4H_4O_6 \frac{1}{2}H_2O$	332.34	2.52158	$Na_2B_4O_7 10H_2O$	382.16	2.58225
Li	7.00	0.84510	NaBr	102.92	2.01250
LiCl	42.46	1.62798	$NaC_2H_3O_2$	82.02	1.91302
Li_2CO_3	74.00	1.86923	$NaC_2H_3O_2 3H_2O$	136.07	2.13370
Li_2O	30.00	1.47712	NaCl	58.46	1.76686
Mg	24.36	1.38506	NaCN	49.01	1.69028
$Mg_2As_2O_7$	310.64	2.49226	Na_2CO_3	106.00	2.02531
$MgBr_2$	184.16	2.26519	$Na_2CO_3 10H_2O$	286.16	2.45661
$MgBr_6H_2O$	292.26	2.46577	$NaHCO_3$	84.01	1.92432
$MgCl_2$	95.24	1.97882	Na_2HPO_4	142.01	2.15231
$MgCl_2 6H_2O$	203.34	2.30823	NaF	149.92	2.17586
$MgCl_2 KCl 6H_2O$	277.90	2.44389	$NaNH_4HPO_4 H_2O$	209.11	2.32037
$MgCO_3$	84.320	1.92593	$NaNO_2$	69.01	1.83891
$MgNH_4PO_6H_2O$	245.46	2.38998	$NaNO_3$	85.01	1.92947
MgO	40.32	1.60552	Na_2O	62.00	1.79259
$Mg_2P_2O_7$	222.64	2.34761	Na_2O_2	78.00	1.89209
$MgSO_4$	120.39	2.08059	NaOH	40.01	1.60215
$MgSO_4 7H_2O$	246.50	2.39182	Na_3PO_4	164.00	2.21484
Mn	54.93		Na_2S	78.07	1.89248
$MnCO_3$	114.93	2.06043	Na_2SO_3	126.07	2.10064
$MnCl_2 4H_2O$	197.91	2.29647	$Na_2SO_3 7H_2O$	252.18	2.40171
MnO	70.93	1.85083	$Na_2S_2O_3 5H_2O$	248.22	2.39483
MnO_2	86.93	1.93917	Na_2SO_4	142.07	2.15250
Mn_2O_3	157.86	2.19828	$Na_2SO_4 10H_2O$	322.23	2.50817
Mn_3O_4	228.79	2.35944	Ni	58.68	1.76849
$Mn_2P_2O_7$	283.86	2.45310	$NiCl_2 6H_2O$	237.68	2.37603
MnS	87.00	1.93952	$Ni(NO_3)_2 6H_2O$	290.80	2.46359
$MnSO_4$	151.00	2.17898			

MOLECULAR AND ATOMIC WEIGHTS AND THEIR LOGARITHMS—Con.

FORMULA	FORMULA WEIGHT		FORMULA	FORMULA WEIGHT	
	Number	Logarithm		Number	Logarithm
NiO	74.68	1.87320	$SbCl_5$	297.50	2.47349
$NiSO_4$	154.75	2.18963	Sb_2O_3	288.40	2.46000
$NiSO_46H_2O$	262.85	2.41971	Sb_2O_5	320.40	2.50569
$NiSO_47H_2O$	280.86	2.44849	$SbOCl$	171.66	2.23467
O	16.00	1.20412	$SbOKC_4H_4O_6\frac{1}{2}H_2O$	332.34	2.52158
O_2	32.00	1.50515	Sb_2S_3	336.61	2.52712
O_3	48.00	1.68124	Sb_2S_5	400.75	2.60287
OH	17.008	1.23065	Si	28.30	1.45179
P	31.00	1.49136	SiF_4	104.30	2.01828
P_2	62.00	1.79219	SiO_2	60.30	1.78032
PCl_3	137.38	2.13783	$Si(OH)_4$	96.33	1.98376
PCl_5	208.30	2.31869	Sn	119.00	2.07555
P_2O_5	142.00	2.15229	$SnCl_2$	189.92	2.27858
Pb	207.10	2.31618	$SnCl_22H_2O$	225.95	2.35402
$Pb(C_2H_3O_2)_23H_2O$	379.20	2.57887	$SnCl_4$	260.84	2.41638
$PbCl_2$	277.02	2.44407	SnO	135.00	2.13033
$PbCO_3$	267.10	2.42667	SnO_2	151.00	2.17898
$(PbCO_3)_2Pb(OH)_2$	775.31	2.88948	SnS	151.07	2.17918
$PbCrO_4$	323.20	2.50947	Sr	87.62	1.94260
PbI_2	460.94	2.66365	$SrCl_2$	158.54	2.20014
$Pb(NO_3)_2$	331.12	2.51999	$SrCl_26H_2O$	266.64	2.42593
PbO	223.10	2.34850	$SrCO_3$	147.62	2.16915
PbO_2	239.10	2.37858	$Sr(NO_3)_2$	211.64	2.32560
Pb_3O_4	685.30	2.83588	$SrSO_4$	183.69	2.26408
PbS	239.17	2.37871	Zn	65.37	1.81538
$PbSO_4$	303.17	2.48169	$ZnCl_2$	136.29	2.13447
Pt	195.00	2.29003	$ZnCO_3$	125.37	2.09819
$PtCl_4$	336.84	2.52742	ZnO	81.37	1.91046
S	32.07	1.50610	$Zn_2P_2O_7$	304.74	2.48393
SO_2	64.07	1.80665	ZnS	97.44	1.98874
SO_3	80.07	1.90347	$ZnSO_4$	161.44	2.20801
Sb	120.20	2.07990	$ZnSO_47H_2O$	287.55	2.45872
$SbCl_3$	226.58	2.35522			

VALUE OF NORMAL SOLUTIONS OF OXIDIZING AND REDUCING AGENTS

SUBSTANCE TITRATED		ATOMIC OR MOLECULAR WEIGHT	1 CC. OF NORMAL SOLUTION IS EQUAL TO GRAMS	
Name	Formula		Number	Logarithm
Ammonium oxalate	$(NH_4)_2C_2O_4$	124.144	0.06272	$\bar{2}.79741$
Antimony	Sb	120.20	0.06010	$\bar{2}.77887$
Arsenic	As	75.00	0.0375	$\bar{2}.57403$
Arsenous acid	H_3AsO_3	126.024	0.06301	$\bar{2}.79942$
Oxide	As_2O_3	198.00	0.0495	$\bar{2}.69461$
Sulphide	As_2S_3	246.18	0.06154	$\bar{2}.78920$
Barium peroxide	BaO_2	169.40	0.0847	$\bar{2}.92788$
Peroxide	$BaO_2.8H_2O$	313.53	0.15676	$\bar{1}.19524$
Thiosulphate	$BaS_2O_3.H_2O$	267.54	0.26754	$\bar{1}.42739$
Bleaching powder	$CaOCl_2$	127.00	0.0635	$\bar{2}.80277$
Bromine	Br	79.96	0.07996	$\bar{2}.90287$
Calcium	Ca	40.10	0.02005	$\bar{2}.30211$
Carbonate	$CaCO_3$	100.10	0.05005	$\bar{2}.69940$
Oxide	CaO	56.10	0.02805	$\bar{2}.44793$
Chlorine	Cl	35.45	0.03545	$\bar{2}.54962$
Chromic anhydride	CrO_3	100.10	0.03337	$\bar{2}.52336$
Oxide	Cr_2O_3	152.20	0.02537	$\bar{2}.40432$
Copper	Cu	63.60	0.0636	$\bar{2}.80346$
Oxide	CuO	79.60	0.0796	$\bar{2}.90091$
Sulphate	$CuSO_4$	159.66	0.15966	$\bar{1}.20319$
Sulphate	$CuSO_4.5H_2O$	249.74	0.24974	$\bar{1}.39749$
Ferric oxide	Fe_2O_3	159.80	0.0799	$\bar{2}.90255$
Ferrous oxide	FeO	71.90	0.0719	$\bar{2}.85673$
Sulphate	$FeSO_4.7H_2O$	278.072	0.27807	$\bar{1}.44415$
Ammonium sulphate	$FeSO_4(NH_4)_2SO_4.6H_2O$	392.26	0.39226	$\bar{1}.59358$
Hydrogen peroxide	H_2O_2	34.016	0.1701	$\bar{2}.23065$
Hydrogen sulphide	H_2S	34.076	0.01704	$\bar{2}.23142$
Iodine	I	126.97	0.12697	$\bar{1}.10370$
Iron	Fe	55.90	0.0559	$\bar{2}.74741$
Lead peroxide	PbO_2	238.90	0.11945	$\bar{1}.07719$
Manganese peroxide	MnO_2	87.00	0.0435	$\bar{2}.63849$
Nitrous acid	HNO_2	47.048	0.04705	$\bar{2}.67254$
Oxalic acid	$H_2C_2O_4$	90.016	0.04501	$\bar{2}.65329$
Oxalic acid	$H_2C_2O_4.2H_2O$	126.048	0.06302	$\bar{2}.79951$
Potassium acid iodate	$KH(IO_3)_2$	390.098	0.03250	$\bar{2}.51199$
Chlorate	$KClO_3$	122.60	0.02043	$\bar{2}.31033$
Chromate	K_2CrO_4	194.40	0.0648	$\bar{2}.81158$
Dichromate	$K_2Cr_2O_7$	294.50	0.04908	$\bar{2}.69093$
Ferrocyanide	$K_4Fe(CN)_6$	368.74	0.36874	$\bar{1}.56672$

VALUE OF NORMAL SOLUTIONS OF OXIDIZING AND REDUCING AGENTS—Con.

SUBSTANCE TITRATED		ATOMIC OR MOLECULAR WEIGHT.	1 CC. OF NORMAL SOLUTION IS EQUAL TO GRAMS	
Name	Formula		Number	Logarithm
Potassium Ferrocyanide cyst.	$K_4Fe(CN)_6.3H_2O$	422.79	0.4228	$\bar{1}$.62613
Iodate	KIO_3	214.12	0.03569	$\bar{2}$.55251
Nitrite	KNO_2	85.19	0.08519	$\bar{2}$.93039
Perchlorate	$KClO_4$	138.60	0.01733	$\bar{2}$.23868
Permanganate	$KMnO_4$	158.15	0.03163	$\bar{2}$.50010
Tetroxalate	$KH_3(C_2O_4)_2.2H_2O$	254.21	0.06355	$\bar{2}$.80314
Sodium chlorate	$NaClO_3$	122.50	0.02042	$\bar{2}$.30999
Ferrocyanide	$Na_4Fe(CN)_6$	304.34	0.03434	$\bar{1}$.48336
Thiosulphate	$Na_2S_2O_3.5H_2O$	248.30	0.24830	$\bar{1}$.39498
Stannous Chloride	$SnCl_2$	189.90	0.09495	$\bar{2}$.97749
Stannous	$SnCl_2.2H_2O$	225.932	0.11297	$\bar{1}$.05294
Tin	Sn	119.00	0.0595	$\bar{2}$.77452

VALUE OF NORMAL SOLUTIONS OF ACIDS AND BASES.

SUBSTANCE	FORMULA	ATOMIC OR MOLECULAR WEIGHT	GRAMS NEUTRALIZED BY 1 CC. NORMAL SOLUTION		INDICATOR
			Number	Logarithm	
Acetic acid	$H.C_2H_3O_2$	58.032	0.05803	2.76367	P.
Ammonia	NH_3	17.064	0.01706	2.23208	M.,L.
Hydroxide	NH_4OH	35.08	0.03508	2.54506	M.,L.
Barium					
Carbonate	$BaCO_3$	197.40	0.09870	2.99432	M.
Hydroxide	$Ba(OH)_2$	171.416	0.08571	2.93302	
Oxide	BaO	153.40	0.07670	2.88480	
Calcium					
Carbonate	$CaCO_3$	100.10	0.05005	2.69940	M.
Hydroxide	$Ca(OH)_2$	74.116	0.03706	2.56889	
Oxide	CaO	56.10	0.02805	2.44793	
Carbon dioxide	CO_2	44.00	0.04400	2.64345	P.
Hydrobromic acid	HBr	80.968	0.08097	2.90831	
Hydrochloric acid	HCl	36.458	0.03646	2.56180	
Hydroiodic acid	HI	127.98	0.01280	2.10713	
Magnesium					
Carbonate	$MgCO_3$	84.36	0.04218	2.62511	M.
Oxide	MgO	40.36	0.02018	2.30492	M.
Nitric acid	HNO_3	63.048	0.06305	2.79968	
Nitrous acid	HNO_2	47.048	0.04705	2.67254	P.
Oxalic acid	$H_2C_2O_4$	90.016	0.04501	2.65329	
Oxalic acid	$H_2C_2O_4.2H_2O$	126.048	0.06302	2.79951	
Phosphoric acid	H_3PO_4	98.024	0.09802	2.99133	M.
Potassium					
Bicarbonate	$KHCO_3$	100.158	0.10016	1.00067	M.
Carbonate	K_2CO_3	138.30	0.06915	2.83979	M.
Hydroxide	KOH	56.158	0.05616	2.74931	
Oxide	K_2O	94.30	0.04715	2.67348	
Sodium					
Bicarbonate	$NaHCO_3$	84.058	0.08406	2.92458	M.
Carbonate	Na_2CO_3	106.10	0.05305	2.72469	M.
Diphosphate	Na_2HPO_4	142.108	0.14211	1.15261	P.
Diphosphate	Na_2HPO_4	358.30	0.35830	1.55425	P.
Hydroxide	$NaOH.12H_2O$	40.058	0.04006	2.60269	
Oxide	Na_2O	62.10	0.03105	2.49206	
Sulphuric acid	H_2SO_4	98.076	0.04904	2.69053	

PERIODIC ARRANGEMENT OF THE ELEMENTS—MENDELEJEFFS (REVISED TO 1911)

SERIES	ZERO GROUP	GROUP I — R_2O	GROUP II — RO	GROUP III — R_2O_3	GROUP IV RH_4 RO_2	GROUP V RH_3 R_2O_5	GROUP VI RH_2 RO_3	GROUP VII RH R_2O_7	GROUP VIII — RO_4		
0											
1		Hydrogen H = 1.008									
2	Helium He = 3.99	Lithium Li = 6.94	Glucinum (Beryllium) Gl = 9.1	Boron B = 11.0	Carbon C = 12.00	Nitrogen N = 14.01	Oxygen O = 16.00	Fluorine F = 19.0			
3	Neon Ne = 20.2	Sodium Na = 23.00	Magnesium Mg = 24.32	Aluminum Al = 27.1	Silicon Si = 28.3	Phosphorus P = 31.04	Sulphur S = 32.07	Chlorine Cl = 35.46			
4	Argon A = 39.88	Potassium K = 39.10	Calcium Ca = 40.09	Scandium Sc = 44.1	Titanium Ti = 48.1	Vanadium V = 51.06	Chromium Cr = 52.0	Manganese Mn = 54.93	Iron Fe = 55.85	Cobalt Co = 58.97	Nickel Ni = 58.68 (Cu)
5		Copper Cu = 63.57	Zinc Zn = 65.37	Gallium Ga = 69.9	Germanium Ge = 72.5	Arsenic As = 74.96	Selenium Se = 79.2	Bromine Br = 79.92			
6	Krypton Kr = 82.9	Rubidium Rb = 85.45	Strontium Sr = 87.63	Yttrium Y = 89.0	Zirconium Zr = 90.6	Columbium (Niobium) Cb = 93.5	Molybdenum Mo = 96.0		Ruthenium Ru = 101.7	Rhodium Rh = 102.9	Palladium Pd = 106.7 (Ag)
7		Silver Ag = 107.88	Cadmium Cd = 112.40	Indium In = 114.8	Tin Sn = 119.0	Antimony Sb = 120.2	Tellurium Te = 127.5	Iodine I = 126.92			
8	Xenon Xe = 130.2	Caesium Cs = 132.81	Barium Ba = 137.37	Lanthanum La = 139.0	Cerium Ce = 140.25	Praseodymium Pr = 140.6	Neodymium Nd = 144.3				
9		Samarium Sa = 150.4		Gadolinium Gd = 157.3	Terbium Tb = 159.2		Erbium Er = 167.4				
10		Thulium Tm = 168.5		Ytterbium (Neoytterbium) Yb = 172.0		Tantalum Ta = 181.0	Tungsten W = 184.0		Osmium Os = 190.9	Iridium Ir = 193.1	Platinum Pt = 195.2 (Au)
11		Gold Au = 197.2	Mercury Hg = 200.0	Thallium Tl = 204.0	Lead Pb = 207.10	Bismuth Bi = 208.0					
12			Radium Ra = 226 4		Thorium Th = 232.0		Uranium U = 238 5				

PLATINUM WIRE TABLE, BROWN AND SHARPE GAUGE

Giving Diameter and Approximate Weight

Gauge No.	10	11	12	13	14	15	16
Diameter in Dec. In.	0.106	0.091	0.081	0.072	0.064	0.057	0.051
Approximate weight in grams, per foot	37.5	28.0	22.0	17.5	14.0	11.0	9.0
Gauge No.	**17**	**18**	**19**	**20**	**21**	**22**	
Diameter in Dec. In.	0.045	0.041	0.036	0.032	0.029	0.026	
Approximate weight in grams, per foot	7.0	5.7	4.4	3.4	2.9	2.3	
Gauge No.	**23**	**24**	**25**	**26**	**27**	**28**	
Diameter in Dec. In.	0.023	0.020	0.018	0.016	0.014	0.013	
Approximate weight in grams, per foot	1.8	1.4	1.1	0.9	0.7	0.6	
Gauge No.	**29**	**30**	**31**	**32**	**33**	**34**	**35**
Diameter in Dec. In.	0.0115	0.010	0.009	0.008	0.007	0.0063	0.0056
Approximate weight in grams, per foot	0.45	0.35	0.28	0.22	0.17	0.15	0.11

VAPOR PRESSURE OF MERCURY

TEMPERATURE	PRESSURE	TEMPERATURE	PRESSURE
	mm.		*mm.*
0	0.02	170	8.091
+20	0.04	180	11.000
40	0.08	190	14.84
60	0.16	200	19.90
80	0.35	210	26.35
100	0.746	220	34.70
110	1.073	230	45.35
120	1.534	240	58.82
130	2.175	250	75.75
140	3.059	260	96.73
150	4.266	270	123.01
160	5.900	280	155.17

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
1	Acetic acid	$HC_2H_3O_2$	60.03	1.0607	17°	118.0°
2	Aluminum	Al	27.10	2.5834°	657°	2200.0°
3	Acetate normal	$Al(C_2H_3O_2)_3$	204.17		decomp.	
4	Bromide	Al_2Br_6	533.72	2.54	93°	263.3°
5	Carbide	Al_4C_3	144 40	2.36		
6	Chloride	Al_2Cl_6	266.96		190°, 2½ At	182.0°
7	Chloride	$Al_2Cl_6.12H_2O$	483 09			
8	Fluoride	Al_2F_6	168 20	3.10		
9	Hydroxide mono-	$Al_2O_3.H_2O$	120 22	3.43		
10	Hydroxide di-	$Al_2O_3.2H_2O$	138 23			
11	Hydroxide tri-	$Al_2O_3.3H_2O$	156 25	2.423	$2H_2O$, 300°	
12	Iodide	Al_2I_6	815.72	2.63	185°	360.0°
13	Nitride	Al_2N_2	82.22			
14	Nitrate	$Al(NO_3)_3.9H_2O$	375.27		73°	dec. 134°
15	Oxide	Al_2O_3	102.20	3.73–3.99	white heat	
16	Phosphate	$AlPO_4$	122.10	2.59	infusible	
17	Sulphate	$Al_2(SO_4)_3$	342.41	2.71		
18	Sulphate	$Al_2(SO_4)_3$ $18H_2O$	666.70	1.62	decomp.	
19	Sulphide	Al_2S_3	150.41	2.37		
20	Alum ammonium	$Al_2(SO_4)_3$. $(NH_4)2SO_4$. $24H_2O$	906.95	$1.645^{\frac{20}{4}}$	94.5°	$23H_2O$,190
21	Ammonium chrom	$Cr_2(SO_4)_3$. $(NH_4)_2SO_4$. $24H_2O$	956.95	1.719		
22	Ammonium iron	$Fe_2(SO_4)_3$. $(NH_4)_2SO_4$. $24H_2O$	964.45	1.712		
23	Potassium	$Al_2(SO_4)_3$. K_2SO_4. $24H_2O$	949.06	$1.7571^{\frac{20}{4}}$	84.5°	$23H_2O$,190
24	Potassium chrom	$Cr_2(SO_4)_3$. K_2SO_4. $24H_2O$	999.06	1.81278°	89.0°	
25	Potassium iron	$Fe_2(SO_4)_3$. K_2SO_4. $24H_2O$	1006.50	1.806		
26	Potassium manganese	$Mn_2(SO_4)_3.K_2$ $SO_4.24H_2O$	1004.70			
27	Sodium	$Al_2(SO_4)_3$. Na_2SO_4. $24H_2O$	916.86	$1.675^{\frac{20}{4}}$	61.0°	
28	Ammonia	NH_3	17.03	0.5971	0 89°	38.5°
				0 6234°liq	77.05°	38 5°
29	Ammonium acetate	$NH_4C_2H_3O_2$	77.07		89 0°	
30	Bromide	NH_4Br	97.96	2.327	sublimes	
31	Carbamate	NH_4HCO_3. NH_4CO_2	157.15		sublimes	
32	Carbonate	$(NH_4)_2CO_3$. H_2O	114.10		dec. 85°	
33	Carbonate acid	NH_4HCO_3	79.05	1.586	dec. 36–60°	
34	Chlorate	NH_4ClO_3	101 50		expl. 102°	
35	Chloride	NH_4Cl	53.50	$1.520^{17°}$		
36	Chloroplatinate	$(NH_4)_2PtCl_6$	443.84	94–3.06	decomp.	
37	Cyanate	NH_4CNO	60.05		decomp.	
38	Molybdate	$(NH_4)_2MoO_4$	196.08	2.38–2.95	decomp.	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot water	Alcohol, acids, alkalies, etc.	
1	∞	∞	∞soluble alcohol	.....
2	insoluble	decomp.	sol. HCl, H_2SO_4, alk.; s. sol. NHO_3	octahedral
3	soluble	decomp.	.....	.....
4	soluble	.....	soluble CS_2, alcohol	.....
5	decomposes, gives CH_4	.....	soluble acids	yellow hexagonal
6	69.87	.....	soluble $CHCl_3$, CCl_4, ether	.....
7	40.0	v. soluble	soluble ether; 50 alcohol	.....
8	soluble	soluble	.....	.....
9	insoluble	insoluble	insoluble acids, alkalies	trimetric
10	insoluble	insoluble	insoluble acids, alkalies	amorphous
11	insoluble	insoluble	soluble acids, alkalies	hexagonal
12	.....	.....	.....	.....
13	slowly decomposes	.....	soluble alkalies	yellow crystals
14	v. soluble	.....	soluble alkalies, 100 alcohol	rhombic
15	insoluble	insoluble	soluble conc. H_2SO_4, alkalies, HCl	rhombohedral
16	insoluble	insoluble	sol. acids, alkalies; insol. $H.C_2H_3O_2$	amorphous
17	36.1	89.1	.....	.....
18	87.	1132.0	insoluble alcohol	octahedral
19	decomp.	.....	soluble acids	yellow crystals
20	3.9	357.0	insoluble alcohol	regular
21	3.95	15.0	soluble alcohol	violet or green regular
22	40.0	400.0	insoluble alcohol	regular
23	5.2	422.0	.....	regular
24	20.0	50.0	insoluble alcohol	green regular
25	20.0	v. soluble	insoluble alcohol	violet regular
26	decomposes	soluble	.....	violet regular
27	107.1	v. soluble	insoluble alcohol	regular
28	104960 cc. 89.9	72722 cc. 67.8	14.8 alcohol, ether	crystals
29	148.0	.....	.....	.....
30	66.2	128.2	soluble alcohol, ether	regular
31	25.0	67.0	.....	.....
32	100.0	.....	insoluble alcohol	plates
33	11.9	27.0	insoluble alcohol	rhombic or monoclinic
34	soluble	.....	soluble alcohol	monoclinic
35	29.4	77.3	s. sol. alcohol, NH_3 methyl alcohol	regular or tetragonal
36	0.67	1.25	0.005 alcohol	yellow regular
37	soluble	decomp.	s. soluble alcohol	.....
38	decomposes	decomp.	insoluble alcohol	monoclinic

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
40	Ammonium molybdate hepta-	$(NH_4)_6Mo_7O_{24}.4H_2O$	1236.3			
41	Nitrite	NH_4NO_2	64.05	1.69	decomp.	
42	Nitrate	NH_4NO_3	80.05	1.725	153°–166°	dec. 210°
43	Oxalate	$(NH_4)_2C_2O_4.H_2O$	142.10	1.502		
44	Persulphate	$(NH_4)_2S_2O_8$	228.20		decomp.	
45	Phosphate di-	$(NH_4)_2HPO_4$	132.09	1.619		
46	Phosphate mono-	$NH_4H_2PO_4$	115.06	1.803		
47	Phosphate meta-	$(NH_4)_4P_4O_{12}$	388.17			
48	Phosphomolybdate	$(NH_4)_3PO_4.12MoO_3.3H_2O$	1931.2			
49	Sulphate	$(NH_4)_2SO_4$	132.14	$1.7687^{\frac{0}{4}}$	140°	dec. 280°
50	Sulphide	$(NH_4)_2S$	68.15		decomp.	
51	Sulphide penta-	$(NH_4)_2S_5$	196.43			
52	Sulphydrate	NH_4HS	51.12		decomp.	
53	Sulphocyanate	NH_4CNS	76.12	$1.3057^{15°}$	159°	
54	Thiosulphate	$(NH_4)_2S_2O_3$	148.22			
55	Antimonic acid	H_3SbO_4	169.21	6.6	decomp.	
56	Antimonic acid pyro-	$H_4Sb_2O_7$	356.43		H_2O 200°	
57	Antimonous acid	H_3SbO_3	153.21		decomp.	
58	Antimony	Sb	120.2	6.62	630°	1500°–1700°
59	Chloride tri-	$SbCl_3$	226.58	$3.064^{26°}$	73.2	223.5°
60	Chloride penta-	$SbCl_5$	297.50	$2.3463^{\frac{15}{4}}$	−6°	102°–103°
61	Hydride (stibine)	SbH_3	123.22	$4.344^{15°}$A	−91.5°	−18°
62	Oxide tri-	Sb_2O_3	288.4	5.2–5.67	red heat	1550°
63	Oxide tetr-	Sb_2O_4	304.4	4.07	O, 800°	
64	Oxide pent-	Sb_2O_5	320.40	3.78	O, 300°	O_2, 800°
65	Oxychloride (ous)	$SbOCl$	171.66			
66	Oxychloride (-ic)	$SbOCl_3$	242.58		decomp.	
67	Sulphate	$Sb_2(SO_4)_3$	528.41	4.89	decomp.	
68	Sulphide tri-	Sb_2S_3	336.61	4.652	fusible	volatile
69	Antimony, potassium tartrate	$K(SbO)C_4H_4O_6.\frac{1}{2}H_2O$	332.33	2.6	$\frac{1}{2}H_2O$, 100°	
70	Argon	A	39.9	1.379 A 19.96 D	−187–9°	
71	Arsenic crystalline	As_4	300.0	$5.727^{14°}$		
72	Acid	$H_3AsO_4.\frac{1}{2}H_2O$	151.03	2.5	35.5°	H_2O, 160°
73	Pentoxide	As_2O_5	230.0	3.99–4.25	red heat	decomp.
74	Sulphide di-(regular)	As_2S_2	214.14	3.4–3.6	307°	565°
75	Sulphide penta-	As_2S_5	310.35		v. fusible	sublimes
76	Chloride	$AsCl_3$	181.38	2.205	−18°	130.2°
77	Hydride (arsine)	AsH_3	78.02	2.695 A	−113.5°	−54.8°
78	Oxide	As_4O_6	396.0	3.65–4.15	sublimes	125°–150°
79	Oxychloride	$AsOCl$	126.46		fusible	
80	Sulphide (orpiment)	As_2S_3	246.21	3.40–3.46	300°	700°
81	Auric chloride	$AuCl_3$	303.58		288°	
82	Chloride	$AuCl_3.2H_2O$	339.61		decomp.	
83	Cyanide	$Au(CN)_3.3H_2O$	383.33			
84	Sulphide	Au_2S_3	490.61			
85	Auroauric chloride	$AuCl_2$	268.12		dec. 250°	
86	Sulphide	AuS	229.27		dec. 140°	
87	Aurous chloride	$AuCl$	232.66			
88	Barium	Ba	137.37	3.78	850°	
89	Acetate	$Ba(C_2H_3O_2)_2.H_2O$	273.43	2.02	decomp.	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot water	Alcohol, acids, alkalies, etc.	
40	soluble			monoclinic
41	soluble	87^{100}	$3.8^{20°}$ alcohol	rhomb. or tetragonal
42	118°	decomp.	soluble alcohol	
43	4.2	41.34		trimetric prisms
44	$58.2^{0°}$			monoclinic
45	25	decomp.	insoluble alcohol	monoclinic
46	171°	260^{21}		tetragonal
47	soluble			tetragonal
48	$03^{15°}$	insoluble	insol. alcohol, HNO_3; sol. alkalies	yellow
49	71°	$103.3^{100°}$	insoluble alcohol	rhombic prisms
50	v. soluble			
51	soluble			orange red
52	v. soluble		soluble alcohol	rhombic
53	$122^{0°}$	$162^{20°}$	soluble alcohol	
54	soluble			rhombic
55	s. soluble	s. soluble	soluble acids and KOH	
56	s. soluble	s. soluble	soluble KOH	
57	insoluble	insoluble	insoluble alcohol	
58	insoluble	insoluble	soluble hot conc. H_2SO_4, aq. r.	hexagonal rhombic
59	$601.6^{0°}$	$4531^{50°}$	soluble alcohol, HCl, $H_2C_4H_4O_6$	rhombic
60	decomposes	decomp.	soluble HCl	
61	20 cc.	4	1500 cc. alcohol, 2500 cc. CS_2	
62	0.0018^{15}	0.01	soluble HCl, KOH, $H_2C_4H_4O_6$	trimetric octahedral
63	insoluble	insoluble	soluble hot concentrated HCl	
64	insoluble	insoluble	soluble HCl, KOH, HI	yellow
65	insoluble	decomp.	insoluble alcohol; soluble HCl, CS_2	monoclinic
66	insoluble	decomp.	soluble alcohol	yellow
67	decomposes	decomp.	soluble H_2SO_4	
68	0.000175	decomp.	soluble alkalies, NH_4HS, K_2S, HCl	black hexagonal
69	5.26	35.7	insoluble alcohol	octahedral
70	5.6 cc.	2.57 cc.		
71	insoluble	insoluble	sol. HNO_3, Cl_2H_2O, aq. r., hot alk.	gray rhombohedral
72	16.7	50	soluble alkalies	
73	150	v. soluble	v. soluble	amorphous
74	insoluble	insoluble	soluble K_2S, $NaHCO_3$	red monoclinic
75	insoluble	insoluble	soluble alkalies, HNO_3	yellow
76	decomposes	decomp.	soluble HBr, HCl, alcohol, ether	needles
77			s. soluble alkalies	
78	1.7	10.14	sol. alk.; alk. carbonates; HCl, al.	amorphous
79	decomposes	decomp.		
80	0.00005	s. soluble	soluble alkalies; alkalies carbonates	yellow or red
81	68	v. soluble	soluble alcohol, ether	red brown leaf
82	soluble	soluble	soluble alcohol	orange
83	v. soluble	v. soluble	soluble alcohol	
84	insoluble		soluble Na_2S, K_2S, insoluble acids	brown
85	decomposes			dark red
86	insoluble	insoluble	insoluble acids; soluble $(NH_4)_2S$	black
87	insoluble	decomp.		yellowish white
88	decomposes	decomp.	soluble alcohol, acids; insoluble benzol, petroleum	silvery crystals
89	$62.9^{4°}$	$80.5^{89°}$	insoluble alcohol	prisms

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
90	Barium Carbide	BaC_2	161.37	3.75		
91	Carbonate	$BaCO_3$	197.37	4.275	1380°	dec. 1450°
92	Chloride	$BaCl_2$	208 29	3 856	960°	
93	Chloride	$BaCl_2.2H_2O$	244.32	3.097	860°	
94	Chromate	$BaCrO_4$	253.47	4.498[15°]		
95	Hydride	BaH_2	139 39	4.21[0°]	volatile	1400°
96	Hydroxide	$Ba(OH)_2.8H_2O$	315.51	1.656	78°	103°
97	Iodide	BaI_2	391.21	5 150[3A]	539°–740°	
98	Nitrate	$Ba(NO_3)_2$	261.39	3.244[23°]	575°	decomp.
99	Oxalate	$BaC_2O_4.H_2O$	243 39	2.6578		
100	Oxide	BaO	153.37	4.73–5.46	BaO_2, 450°	
101	Peroxide	BaO_2	169.37	4.96	O, 450°	
102	Platinocyanide	$BaPt(CN)_4.4H_2O$	508.47	3.054		
103	Sulphate	$BaSO_4$	233.44	4.476 4.330	1580°	
104	Sulphite	$BaSO_3$	217.44			
105	Bismuth	Bi	208.0	9.7474	269°	1435°
106	Carbonate sub-	$Bi_2O_3CO_2.H_2O$	526.02	6.86	decomp.	
107	Chloride di-	$BiCl_2$	278 9	4.86	163[d]	dec. 300°
108	Chloride tri-	$BiCl_3$	314.38	4.56[11°]	227°	435°–447°
109	Hydroxide	$Bi(OH)_3$	259.02		H_2O, 100°	
110	Nitrate	$Bi(NO_3)_3.5H_2O$	484.11	2 78	74°	dec. 75°–80°
111	Nitrate sub-	$BiONO_3.H_2O$	304.03	4.928[15°]	dec. 260°	
112	Oxide tri-	Bi_2O_3	464 00	8.8–9 0	820°–860°	
113	Oxide penta-	Bi_2O_5	496.00		O, 150°	O_2, 357°
114	Oxychloride	BiOCl	259.46	7.717	red heat	
115	Sulphate	$Bi_2(SO_4)_3$	704.21			
116	Sulphide	Bi_2S_3	512.21	7.00–7.81	decomp.	
117	Boric acid	H_3BO_3	62.02	1.4347[15°]	184°–186°	
118	Boron	B	11.0	2.45 2.53–2.68	infusible infusible	sublimes 3500°
119	Chloride	BCl_3	117.38	1.434[0]		18.2°
120	Oxide	B_2O_3	70.00	1.75–1.83	577°	high temp.
121	Sulphide tri-	B_2S_3	118 21	1.55	310°	
122	Sulphide penta-	B_2S_5	182.35	1.85	390°	
123	Bromine	Br_2	159.84	3.1883°	−7.3°	58.7°
124	Cadmium	Cd	112.4	8.642[17°]	321.7°	778°
125	Carbonate	$CdCO_3$	172.40	4 258	decomp.	
126	Chloride	$CdCl_2$	183.32	4.05	560°	861°–812°
127	Chloride	$CdCl_2.2H_2O$	219 35	3.327		
128	Hydroxide	$Cd(OH)_2$	146.42	4.79[15°]	H_2O, 300	
129	Nitrate	$Cd(NO_3)_2.4H_2O$	308.48	2.455	59.5	132°
130	Phosphate	$Cd_3(PO_4)_2$	527 2			
131	Sulphate	$CdSO_4$	208.47	4.72	1000	
132	Sulphate	$3CdSO_4.8H_2O$	769.54	3.05		
133	Sulphide artificial	CdS	144.47	3.9–4.8	wht. heat	
134	Calcium	Ca	40.09	1.5446[20.3°]	780°–810°	
135	Acetate	$Ca(C_2H_3O_2)_2.H_2O$	176.15		decomp.	
136	Aluminate	$CaAl_2O_4$	158.3	3.671[20°]		
137	Ammonium phosphate	$CaNH_4PO_4.7H_2O$	279.24	1.56115[0°]	decomp.	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
Cold water	Hot water	Alcohol, acids, alkalies, etc.	
decomposes to C_2H_2		decomposes by acids	gray crystals
0.0022[20°]	0.0065[100°]	soluble acids, NH_4Cl	rhombic
30.9°	62.7[100°]	insoluble alcohol; s. soluble HCl	
36.2	73.5	HNO_3	
0.00038[12°]	0.0043	soluble HCl, HNO_3	yellow rhombic
decomposes	decomp.		crystalline
5.56[15°]	182.7[80°]	soluble alcohol; insoluble ether	tetragonal
170°	272[100°]	v. soluble alcohol	rhombic
5.2°	32.2[100°]	insoluble alcohol; s. soluble acids	regular
0.0093[18]	0.0228[100°]	sol. acids NH_4Cl; insol. alcohol	
1.5°	90.8[80°]	soluble HCl, HNO_3	amorphous
insoluble	decomp.	soluble dilute acids	
3[16°]			gray to yellow mono.
0.000172°	0.0003[34°]	0.006, 3% HCl; soluble conc. H_2SO_4	rhombic
0.0197[20°]	0.00177[80°]	v. soluble HCl	hexagonal
insoluble	insoluble	soluble HNO_3, aq. r., conc.	reddish rhombic
insoluble		soluble acids; insoluble Na_2CO_3	
decomposes			black needles
decomposes		soluble alcohol, acids, acetone	
insoluble		soluble acids; insoluble alkalies	
decomposes		soluble acids, 40[18] acetone	
insoluble		soluble acids	hexagonal plates
insoluble		soluble acids; insoluble alkalies	yellow tetragonal
insoluble		soluble acids, concentrated, KOH	brown
insoluble		soluble acids; insoluble $H_2C_4H_4O_6$	quadratic
	decomp.	soluble acids	needles
0.000018		soluble HNO	brown rhombic
3.9[18°]	34[100°]	0.24[25°] ether, soluble alcohol, 28[20°], 72[180°] glycerine	triclinic monoclinic
insoluble	insoluble	insol. alcohol, ether; sol. conc. HNO_3, concentrated H_2SO_4	monoclinic
insoluble	insoluble	decomposed by alcohol	
decomposes		soluble alcohol, concentrated acids	
1.16°	16.4[102°]	s. soluble, PCl_3, SCl_2	crystals
decomposes			crystalline
decomposes			
4.176°	3.49[90°]	soluble alkalies, CS_2, ether, alcohol, $CHCl_3$ KBr, H_2O	brown red crystals
insoluble	insoluble	soluble acids, NH_4NO_3	crystalline
insoluble	insoluble	soluble acid, NH_4 salts	
140[20°]	150[100°]	1.52[15°] alcohol	
168[20°]	180[100°]	2.05[15°] methyl alcohol	monoclinic
0.00026[25°]	insoluble	alkalies; soluble acids, NH_4	hexagonal
143.4°		soluble alcohol; insoluble HNO_3	prism needles
insoluble		soluble NH_4 salts, acids	amorphous
76.5°	60.8[100°]		
114.2°	87[100°]		monoclinic
00013	colloidal sol.	v. s. soluble NH_4OH; soluble acids	yellow hexagonal
insoluble			
decomposes	decomp.	soluble acids, sodium; insoluble	silvery hexagonal
43.6°	34.2[100°]	s. soluble alcohol	needles
decomposes		insoluble benzine; soluble HCl	prismatic needles
insoluble	insoluble	soluble acids	monoclinic

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
	Calcium					
138	Carbide	CaC_2	64.09	$2.22^{18°}$		
139	Carbonate	$CaCO_3$	100.09	2.72–2.95	dec. 825°	
140	Chloride	$CaCl_2$	111.01	$2.26^{30°}$	774°	
141	Chloride	$CaCl_2.H_2O$	129.03			
142	Chloride	$CaCl_2.6H_2O$	219.11	1.654	29.48°	129°–130°
143	Chromate	$CaCrO_4.2H_2O$	192.22		$2H_2O$, 200°	
144	Fluoride	CaF_2	78.09	3.15–.18	902°–1330°	
145	Fluosilicate	$CaSiF_6$	183.39	$2.662^{17.5°}$		
146	Hydroxide	$Ca(OH)_2$	74.11	2.078		
147	Hypochlorite	$Ca(ClO)_2.4H_2O$	215.07		decomp.	
148	Nitrate	$Ca(NO_3)_2$	164.11	2.36	561°–499°	
149	Nitrate	$Ca(NO_3)_2.4H_2O$	236.17	1.82	42.31°	132°
150	Oxalate	$CaC_2O_4.H_2O$	146.11	2.2	decomp.	
151	Oxide	CaO	56.09	3.15–3.40	infusible	
152	Phosphate	$Ca_3(PO_4)_2$	310.27	3.18		
153	Phosphate di-	$CaHPO_4.2H_2O$	172.13	$2.317^{15°}$	decomp.	
154	Phosphate mono-	$CaH_4(PO_4)_2$ H_2O	252.14	2.02	H_2O, 100°	dec. 200°
155	Silicate	$CaSiO_3$	116.30	2.88	1512°	
157	Sulphate	$CaSO_4$	136.16	2.964		
158	Sulphate (gypsum)	$CaSO_4.2H_2O$	172.19	2.32	$2H_2O$, 80°	
159	Carbon amorphous	C	12.00	1.75–2.10	sublimes	
160	Carbon graphite	C	12.00	2.255	at	
161	Carbon diamond	C	12 00	3.47–3.5585	3500°	
162	Chloride tetra-	CCl_4	153.84	$1.58173^{\frac{15}{4}}$	−23.77°	76.74°
163	Dioxide gaseous	CO_2	44.00	1.53 A		
164	Dioxide liquid	CO_2	44.00	$1.057^{-34°}$	−65°	78.2°
165	Dioxide solid	CO_2	44.00	$1.56^{-79°}$	−65°	78.2°
166	Disulphide	CS_2	76.14	$1.292^{\frac{0}{4}}$ 63A	−110	46.2°
167	Monoxide	CO	28.00	0.9670 A	−203°	190°
168	Chlorine	Cl_2	70.92	2.491° A	−102°	−33.6°
169	Hydrate	$Cl_2.5H_2O$	125.54	1.23	−50°	
170	Oxide mon-	Cl_2O	86.92	2.977 A	−20°	−5°
171	Oxide di- or per-	ClO_2	67.46	1.5, 2.315 A	−79°	9.9°
172	Oxide hept-	Cl_2O_7	182.92			82°
173	Chromium	Cr	52.1	$6.92^{28°}$	1515°	
174	Dioxide	CrO_2	84.10		190, O, 300°	
175	Trioxide	CrO_3	100.10	2.67–2.82	196°	decomp.
176	Carbide	Cr_3C_2	180.3	5.62		
177	Chloride	$CrCl_2$	158.48	$2.757^{15°}$	1200°–1500°	
178	Chloride	$CrCl_2.6H_2O$	266.58		sublimes	
179	Hydroxide	$Cr(OH)_3$	103.12			
180	Nitrate	$Cr(NO_3)_3.9H_2O$	400.27		37°	125.5°
181	Oxide	Cr_2O_3	152.20	5.04	dec. 400°	
182	Sulphate	$Cr_2(SO_4)_3$	392.41	3.012		
183						
	Chromous					
184	Carbonate	$CrCO_3$	112.10			
185	Chloride	$CrCl_2$	123.02	$2.751^{14°}$		
186	Hydroxide	$Cr(OH)_2$	86.12			
187	Sulphate	$CrSO_4.7H_2O$	274.28			
188	Sulphide	CrS	84.17	4.08		
189	Chromyl trichloride	CrO_2Cl_2	155.02	$1.9617^{\frac{0}{4}}$		115.9°
190	Cobalt	Co	58.97	$8.718^{\frac{1}{4}}$	1464°	
191	Cobaltic chloride	$CoCl_3$	165.38	2.94	sublimes	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot water	Alcohol, acids, alkalies, etc.	
138	decomp. to	C_2H_2		crystalline
139	0.0013	0.088	0.1 CO_2 aqua; sol. acids, NH_4Cl	rhombic
140	59.5°	154^{100}°	soluble alcohol	
141	59.1°	205^{99}°	soluble alcohol	
142	117.4°		soluble alcohol	hexagonal
143	22.2°	4.3^{100}°	soluble alcohol, acids	yellow prisms
144	0.0016^{18}		s. soluble concentrated acids	regular
145	s. soluble		soluble HF, HCl, alcohol	
146	0.170°	0.08^{100}°	soluble NH_4Cl	hexagonal
147	deliques	decomp.		
148	93.1°	351 2^{15}°	14^{15} alcohol; soluble amyl. alcohol	prisms
149	134°	506^{153}°	0.8 alcohol	monoclinic
150	0.00068^{26}°	0.0014^{95}°	soluble a.; insoluble $H.C_2H_3O_2$	octahedral
151	0.13°	0.06^{100}°	soluble acids	regular
152	0.003–0.008	decomp.	soluble acids; insoluble alcohol	amorphous
153	0.028	decomp.	insol. alcohol; soluble $H_4C_6H_7O_7$	monoclinic plates
154	4^{15}°	decomp.		rhombic
155	0.0095^{17}°		soluble HCl	monocl. or hexagonal
157	0.179°	0.178^{100}°	soluble acid $Na_2S_2O_4.NH_4$ salts	rhombic
158	0.241°	0.222^{100}°	soluble HCl, NaCl, glycerine	monoclinic
159	insoluble	insoluble	insoluble in acids, alkalies; soluble in molten metals	black amorphous
160	insoluble	insoluble		black hexagonal
161	insoluble	insoluble		regular
162	insoluble			
163	179.67 cc.	190.14 cc.^{20}	283 cc.$^{22-6}$° alcohol, soluble alkalies	
164	insoluble		soluble alcohol, ether	
165				crystalline
166	0.2°	0.014^{30}°	soluble alcohol, ether	
167	3.5 cc. 0°	1.6 cc. 50°	0.20566^{18}° alcohol soluble Cu_2Cl_2	
	0.0044°	0.0018^{40}°	CS_2, $C_6H_6H.C_2H_3O_2$	
168	150°, 300^{10}°	180^{30}° cc.	soluble alkalies	greenish yellow
169	soluble			octahedral
170	200 cc. 8°			reddish yellow
171	20000 cc. 4°	decomp.	soluble conc. H_2SO_4 alkalies	yellowish green
172	soluble		soluble benzene	oil
173	insoluble	insoluble	soluble HCl, dil. H_2SO_4; insoluble	gray crystalline
174	insoluble			dark gray
175	163.4°	206.7^{100}°	soluble alcohol ether H_2SO_4	red triclinic
176	insoluble	insoluble	soluble dilute HCl	gray crystals
177	insoluble	s. soluble	insoluble acids; soluble trace $CrCl_2$	pink crystals
178	v. soluble		soluble alcohol	violet plates
179	insoluble		soluble a., alkalies; s. sol. NH_3 aq	violet plates; gray hexagonal plates; gray green or purple prisms
180	soluble			
181	insoluble		s. soluble acids	dark green hexagonal
182	insoluble		insoluble acids	
183				
184	insoluble		insoluble ether	amorphous
185	v. soluble			crystalline
186	decomp.		soluble acids	yellow brown
187	12.35°		s. soluble alcohol	blue
188	insoluble		v. soluble acids	black powder
189	decomp.			dark red
190	insoluble	insoluble	soluble acids	
191	soluble	soluble		

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
192	Chloride purpureo	$Co(NH_3)_5Cl_3$	250.57	1.802[15°]		
193	Hydroxide	$Co(OH)_3$	110.02			
194	Oxide	Co_2O_3	166.00	4.81–5.60	dec. red	heat
195	Sulphate	$Co_2(SO_4)_3$	406.15			
196	Sulphide	Co_2S_3	214.15	4.8		
	Cobaltocobaltic					
197	Oxide	Co_3O_4	240.91	5.8–6.3		
198	Carbonate	$CoCO_3$	118.97		decomp.	
199	Carbonate basic	$2CoCO_3.3Co(OH)_2$	516.90			
200	Chloride	$CoCl_2$	129.89	2.3487[5]	sublimes	
201	Chloride	$CoCl_2.6H_2O$	238.00	1.84	86.75°	
202	Cobaltous cyanide	$Co(CN)_2.2H_2O$	147.02		$2H_2O$, 280°	
203	Hydroxide	$Co(OH)_2$	93.00	3.597[15°]		
204	Nitrate	$Co(NO_3)_2.6H_2O$	291.09	1.83[14°]	56°	
205	Oxalate	$CoC_2O_4\ 2H_2O$	183.00	2.325[19°]		
206	Oxide	CoO	74.97	5.6–5.75		
207	Phosphate	$Co_3(PO_4)_2$	366.91			
208	Sulphate	$CoSO_4$	155.04	3.472[15°]	989°	
209	Sulphate	$CoSO_4.7H_2O$	281.15	1.918[15°]	96.8°	
210	Sulphide	CoS	91.04	5.45		
211	Copper nitride	Cu_3N	204.72		dec. 300°	
212	Cupric acetate	$Cu(C_2H_3O_2)_2H_2O$	199.63	1.9	dec. 240°	
213	Aceto-arsenite	$(CuOAs_2O_3)_2.Cu(C_2H_3O_2)_2$	966.36			
214	Ammonium chloride	$CuCl_2 2NH_4Cl.2H_2O$	277.53	1.96–1.97	$2H_2O$, 120°	
215	Arsenite paris green	$CuHAsO_3$	187.58		decomp.	
216	Carbonate basic	$CuO_2Cu(OH)_2$	221.16	3.7–4.0	decomp.	
217	Carbonate basic	$2CuCO_3.Cu(OH)_2$	344.73	3.88	decomp.	
218	Chloride	$CuCl_2$	134.49	3.054	498°	decomp.
219	Chloride	$CuCl_2.2H_2O$	170.52	2.47–2.535	$2H_2O$, 100	
220	Chromate basic	$CuCrO_4.2CuO.2H_2O$	374.84		$2H_2O$, 260	
221	Ferricyanide	$Cu_3[Fe(CN)_6]_2$	678.13			
222	Ferrocyanide	$Cu_2Fe(CN)_6.7H_2O$	465.16			
223	Hydroxide	$Cu(OH)_2$	97.59	3.368	decomp.	
224	Nitro prusside	$CuFe(CN)_5NO.2H_2O$	331.51			
225	Nitrate	$Cu(NO_3)_2.3H_2O$	241.64	2.174	114.5°	
226	Nitrate	$Cu(NO_3)_2.6H_2O$	295.69	2.074	26.4°	
227	Oxalate	$CuC_2O_4.\frac{1}{2}H_2O$	160.58			
228	Oxide	CuO	79.57	6.32–6.43	1064°	
229	Cupric phosphate	$Cu_3(PO_4)_2.3H_2O$	434.76			
230	Sulphate	$CuSO_4$	159.64	3.516[20°]		
231	Sulphate	$CuSO_4.5H_2O$	249.72	2.284[15°]	$4H_2O$, 110°	
232	Sulphide	CuS	95.64	3.8–4.16		
233	Cuprous chloride	Cu_2Cl_2	198.06	3.38–3.68	434°	954°–1032
234	Ferricyanide	$Cu_3Fe(CN)_6$	402.62			
235	Ferrocyanide	$Cu_4Fe(CN)_6$	466.19			
236	Hydroxide	$CuOH$	80.58		$\frac{1}{2}H_2O$, 360°	
237	Oxide	Cu_2O	143.14	5.75–6.09	red heat	
238	Sulphide	Cu_2S	159.21	5.52–5.82	1100°	
239	Sulphocyanate	$CuCNS$	121.65			
240	Cyanogen chloride	$CNCl$	61.47	2.13 D	−18°	15.5°

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot Water	Alcohol, acids, alkalies, etc.	
192	0.232°	1.031$^{46.6°}$	insoluble alcohol	.....
193	insoluble	insoluble	insol. alcohol; sol. conc. cold acids	black
194	insoluble	insoluble	soluble concentrated acids	steel gray
195	sol. with dec.	.....	soluble concentrated, H_2SO_4	blue cryst. powder
196	insoluble	.....	decomposes by acids	black crystals
197	insoluble	insoluble	soluble concentrated H_2SO_4	black
198	insoluble	insoluble	insoluble conc. HCl, HNO_3	red rhombohedral
199	insoluble	decomp.	soluble $(NH_4)_2CO_3$	red colored
200	45?°	105$^{96°}$	31 alcohol, 8.62 acetone	blue crystals
201	76.70°	190.$^{710°}$	v. soluble ether, glycoll	red monoclinic
202	insoluble	.....	soluble KCN, HCl, NH_3 aqua	buff colored
203	insoluble	insoluble	insoluble alkalies; soluble NH_4 salts	rose red
204	133.8°	.....	100$^{12.5°}$ alcohol	red monoclinic
205	insoluble	.....	soluble acid, NH_3 aqua	reddish white
206	insoluble	insoluble	sol. acid, NH_3 aqua; insol. alkalies	greenish brown
207	insoluble	insoluble	soluble $H_3PO_4NH_3$ aqua	reddish
208	26.2°	82.6$^{03°}$	1.04$^{18°}$ methyl alcohol	red powder
209	60.4^{20}	soluble	2.5° alcohol	.....
210	0.00038	.....	soluble conc. HCl., aq. r., alcohol	brown needles
211	.....	.....	decomposes by acids	.....
212	7.2	20	7.143 alcohol; soluble ether	dark green
213	insoluble	.....	soluble acids NH_3 aqua	green
214	33.8°	99.3$^{80°}$	soluble alcohol	light blue rhombic
215	insoluble	.....	soluble acids, NH_3 aqua	light green
216	insoluble	decomp.	0.026, CO_2 aqua; soluble KCN	dark green monoclinic
217	insoluble	decomp.	soluble NH_3 aq., hot $NaHCO_3$ aq.	
218	70.6°	107.$^{910°}$	53$^{15.5°}$ alcohol, 68$^{15.5°}$ methyl	brownish yellow
219	110.4°	192.$^{410°}$	sol. NH_4Cl ether alcohol	blue rhombic
220	insoluble	.....	soluble HNO_3, NH_3 aqua	yellowish brown
221	insoluble	.....	insoluble HCl; soluble NH_3 aqua	yellowish green
222	insoluble	.....	insoluble acids, soluble NH_3 aqua	brown red
223	insoluble	decomp.	soluble alcohol, NH_4Cl $Na_2S_2O_3$	blue crystals
224	insoluble	.....	decomposes by alkalies	greenish
225	137.8°	1270$^{100°}$	100$^{12.5°}$ alcohol	blue prismatic
226	243.7°	.....	soluble alcohol	crystalline
227	insoluble	.....	insoluble $H.C_2H_3O_2$	bluish white
228	hygroscopic	.....	soluble acids, NH_4Cl, KCN	black monoclinic
229	insoluble	.....	soluble acids, NH_3 aqua	blue green
230	20°°	194$^{100°}$	insoluble	.....
231	31.61°	203 3$^{100°}$	insoluble alcohol K_2S	blue triclinic
232	0.0001	.....	soluble HNO_3, KCN; insoluble	black
233	insoluble	.....	soluble HCl, NH_3 aqua, NH_4Cl	tetrahedral
234	insoluble	.....	soluble NH_3 aqua, insoluble HCl	brownish red
235	insoluble	.....	soluble NH_3 aqua, insoluble NH_4Cl	brown red
236	insoluble	insoluble	soluble acids, NH_3 aqua	yellow
237	insoluble	insoluble	soluble NH_3 aqua NH_4Cl, HCl	carmine (red)
238	0.0005	.....	soluble HNO_3 alcohol, ether	rhombic or regular
239	25 cc.	.....	4.4 cc. alcohol, soluble ether	.....
240	soluble	.....	v. soluble alcohol, ether	prisms

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 (A) AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
241	Ferric acetate basic	$FeOH(C_2H_3O_2)_2$	190.91			
242	Chloride	$FeCl_2$	162.23	2.804	301°	
243	Chloride	$FeCl_3.6H_2O$	270.33		37°	280°-285°
244	Ferrocyanide (prussian blue)	$Fe_4[Fe(CN)_6]_3$	859.13		decomp.	
245	Hydroxide	$Fe(OH)_3$	106.87	3.4-3.9	$1\frac{1}{2}H_2O$, 500°	
246	Nitrate	$Fe(NO_3)_3.9H_2O$	404.02	$1.6835^{29°}$	47 2°	decomp.
247	Oxalate	$Fe_2(C_2O_4)_3$	375.70		dec. 100°	
248	Oxide	Fe_2O_3	159.70	5.12-5.24		
249	Phosphate	$FePO_4.4H_2O$	222.91	2.87		
250	Sulphate	$Fe_2(SO_4)_3$	399.91	3.097	decomp. at	
251	Sulphate	$Fe_2(SO_4)_3.9H_2O$	562.05	2-2.1		
252	Sulphide	Fe_2S_3	207.91	4.25-4.41	decomp.	
253	Ferrous Ammonium sulphate	$FeSO_4(NH_4)_2SO_4.6H_2O$	392.17	1.865		
254	Carbonate	$FeCO_3$	115.85	3.70-3.87	decomp.	
255	Carbonate	$FeCO_3.H_2O$	133.87		decomp.	
256	Chloride	$FeCl_2$	126.77	2.988		
257	Chloride	$FeCl_2.4H_2O$	198.83	1.93		
258	Ferricyanide (turnbulls blue)	$Fe_3[Fe(CN)_6]_2$	591.37		decomp.	
259	Ferrocyanide	$Fe_2Fe(CN)_6$	323.61			
260	Hydroxide	$Fe(OH)_2$	89.87			
261	Nitrate	$Fe(NO_3)_2.6H_2O$	287.97		60.5°	
262	Sulphate	$FeSO_4.7H_2O$	278.03	1.86-1.90	64°	
263	Sulphide	FeS	87.92	4.75-5.04	red heat	
264	Ferroso-ferric (choride)	$FeCl_2.2FeCl_3.18H_2O$	613.27		dec. 50°	
265	Ferricyanide (prussian green)	$Fe'''_4Fe''_3[Fe(CN)_6]_6$	1662.4		dec. 180°	
266	Hydrate	$Fe_2O_3.4H_2O$	303.61		decomp.	
267	Oxide	Fe_3O_4	231 55	4.96-5.40		
268	Fluorine	F_2	38.0	$\{1.31^{15}$ A $\}$ $\{1.14$-$187°\}$	−223°	−187°
269	Fluosilicic acid	H_2SiF_6	144.32			
270	Gold	Au	197.2	19.32	1060°	2530°
271	Colloidal	Au	197.2			
272	Helium	He	4.0	$\{0.1368$A $\}$ $\{1.98$D $\}$	−271.3°	−267°
273	Hydrazine	$N_2H_2NH_2$	32.05	$1.0113^{\frac{15}{4}}$	1.4°	113.5°
274	Hydroxide	$N_2H_4H_2O$	50.07	1.0305^{21}	−40°	119°
275	Sulphate	$N_2H_4.H_2SO_4$	130 14		254°	
276	Nitrate	$N_2H_4.HNO_3$	95.07		69°	
277	Hydrazoic acid	HN_3	43.04		−80°	37°
278	Hydrobromic acid	HBr	80.93	1.278 A	−86.13°	−68.7°
279	Hydrobromic acid	$HBr.H_2O$	98 95	1.78		
280	Hydrochloric acid	HCl	36.47	$1.1958^{0°}$	−112.5°	83 1°
281	Hydrocyanic acid	HCN	27.02	$0.6971^{8°}$	−15°	26.1°
282	Hydrofluoric acid	HF	20 01	$0.9879^{15°}$	−92.3°	19.44°
283	Hydroiodic acid	HI	127.93	4.3737 A	−51.3°	36.7
284	Hydrogen	H_2	2.016	0.06949	−256.5°	−252.5°
285	Peroxide	H_2O_2	34 02	1.4584	−2°	80.2°
286	Sulphide	H_2S	34.09	0.91 1895A	−85.5°	−61 8
287	Hydroxylamine	NH_2OH	33 03	$1.2271^{\frac{15}{4}}$	33.05°	70.60mm.
288	Hydrochloride	$NH_2OH.HCl$	69 50		151°	decomp.
289	Iodic acid	HIO_3	175.93	4.6239°	$\frac{1}{2}H_2O$° 190°	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot water	Alcohol, acids, alkalies, etc.	
241	insoluble	.....	soluble alcohol, acids	amorphous
242	74.3 $9^{0°}$	536 $6^{100°}$	v. soluble alcohol, ether + HCl	brown hexagonal
243	$246^{0°}$	625.8	soluble alcohol	.....
244	insoluble	.....	insoluble alcohol, ether soluble concentrated HCl, H_2SO_4	dark blue crystals
245	insoluble	insoluble	insoluble alcohol, ether	reddish brown
246	v. soluble	v. soluble	soluble alcohol	rhombic
247	v. soluble	.....	insoluble alcohol	amorphous or monocl.
248	hygroscopic	insoluble	soluble acids	.....
249	insoluble	0.067	insoluble $H.C_2H_3O_2$	yellow rhombic
250	s. soluble	decomp.	insoluble concentrated H_2SO_4	amorphous
251	v. soluble	decomp.	dec. by alcohol; soluble ab. alcohol	yellow rhombic
252	decomp.	.....	decomposes by acids	greenish yellow
253	$18^{0°}$	78.2 $75^{0°}$	insoluble alcohol	blue green monoclinic
254	insoluble	insoluble	soluble CO_2 aqua	.....
255	s. soluble	.....	soluble acids, CO_2 aqua	amorphous
256	64.4 $10^{0°}$	105.7 $100^{0°}$	100 alcohol	.....
257	160.1 $10^{0°}$	415.5 $100^{0°}$	soluble alcohol	blue green monoclinic
258	insoluble	.....	insoluble alcohol, dilute acids	deep blue
259	insoluble	.....	.....	white blue amorphous
260	0.00067	.....	soluble NH_4Cl acids	pale green crystals
261	$200^{0°}$	300 $25^{0°}$	.....	crystals
262	32.8 $8^{0°}$	196.4 $76^{0°}$	insoluble alcohol	blue green monoclinic
263	0.00089	.....	soluble acids	black hexagonal
264	deliques	.....	.....	yellow
265	insoluble	.....	soluble concentrated hot HCl	green
266	insoluble	insoluble	soluble acids	black
267	insoluble	insoluble	insoluble alcohol	black octahedral
268	decomp.	decomp.	.....	greenish yellow
269	soluble	.....	.....	.....
270	insoluble	insoluble	insoluble acid; soluble KCN, aq. r.	yellow regular
271	soluble	.....	Insoluble acid; sol. alkalies, aq. r.	blue violet
272	1.487 cc. $^{0-5}$	1.371 cc. ^{25}	absorbed by platinum	crystalline
273	v. soluble	.....	soluble alcohol	crystalline
274	.....	v. soluble	soluble alcohol; insoluble ether	.....
275	s. soluble	v. soluble	insoluble alcohol	tables
276	.....	.....	.....	.....
277	.....	.....	soluble alcohol	liquid
278	221.2 $0^{0°}$	130 $100^{0°}$	soluble alcohol	crystalline
279	.....	.....	.....	.....
280	82.5 $10^{0°}$	56.1 $60^{0°}$	soluble alcohol, ether	.....
281	.....	.....	soluble alcohol, ether	crystalline
282	264	.....	.....	.....
283	42500 cc. $^{10°}$	.....	soluble alcohol	.....
284	2.1 cc. $^{0-50°}$	.....	soluble palladium, charcoal	.....
285	.....	.....	soluble ether, alcohol	prisms
286	437 cc. $^{0°}$	186 cc. $^{40°}$	9.54 $^{20°}$ vol. al.	.....
287	soluble	decomp.	soluble alcohol, acids	crystalline
288	v. soluble	.....	soluble alcohol; insoluble ether	monoclinic
289	$286^{0°}$	471 $^{80°}$	v. soluble alcohol, HNO_3	trimetric

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
290	Iodine	I_2	253.84	4.9487°	114.2°	184.35°
291	Iron pure	Fe	55.85	7.85–7.88	1505°	
292	Wrought	Fe	55.85	7.86	1600°	
293	White pig	Fe	55.85	7.58–7.73	1075°	
294	Gray pig	Fe	55.85	7.03–7.13	1275[c]	
295	Steel	Fe	55.85	7.60–7.80		
296	Cast Steel	Fe	55.85		1357°	
297	Boride	FeB	66.85	7.15[18°]		
298	Carbide	Fe_3C	179.55	7.07[16°]		
299	Carbide	FeC_4	103.85			
300	Disulphide	FeS_2	120.02	4.86–5.18	1171°	decomp.
301	Nitride	Fe_2N	125.71	6.35	dec. 200°	
302	Krypton	Kr	81.8	{ 2.818A / 40.78D }	−169°	151.7°
303	Lead	Pb	207.1	11.34	327°	1580°
304	Acetate sugar	$Pb(C_2H_3O_2)_2$. $3H_2O$	379.20	2.50	75°, $3H_2O$	280°
305	Acetate basic	$Pb_3(C_2H_3O_2)_2$ OH	608.28			
306	Acetate basic	$Pb(C_2H_3O_2)_2$ $Pb(OH)_2$. H_2O	584.28			
307	Acetate basic	$Pb(C_2H_3O_2)_2$. $2Pb(OH)_2$	807.38			
308	Carbonate	$PbCO_3$	267.10	6.43		
309	Carbonate basic	$2PbCO_3$. Pb $(OH)_2$	775.31		decomp.	
310	Chloride	$PbCl_2$	277.02	5.80	498°	861°–954°
311	Chromate	$PbCrO_4$	323.20	6.123[15°]	fusible	
312	Chromate basic (chrome red)	$PbCrO_4$. PbO	546.30			
313	Hydroxide	2PbO. H_2O	484.22		dec. 145°	
314	Hydroxide	3PbO. H_2O	687.32	7.592	H_2O. 130°	
315	Iodide	PbI_2	460.94	6.12	373°	861°–954°
316	Nitrate	$Pb(NO_3)_2$	331.12	4.53[24°]		
317	Oxalate	PbC_2O_4	294.9	5.025	dec. 300°	
318	Oxide mon-	PbO	223.10	9.375	906°	white heat
319	Oxide mon-	PbO	223.10	8.74[14°]		white heat
320	Oxide mon-	PbO	223.10	9.2–9.5	red heat	white heat
321	Oxide sub-	Pb_2O	430.20	8.342		
322	Oxide sesqui-	Pb_2O_3	462.20		dec. 370°	
323	Oxide red (minimum)	Pb_3O_4	685.30	9.096	dec. 500°	
324	Oxide per-	PbO_2	239.10	8.91	decomp.	
325	Phosphate	$Pb_3(PO_4)_2$	811.30	6.9–7.3		
326	Sulphate	$PbSO_4$	303.17	6.23	937°	
327	Sulphate acid	$Pb(HSO_4)_2$. H_2O	419.27			
328	Sulphate basic	$PbSO_4$. PbO	526.27			
329	Sulphide	PbS	239.17	7.13–7.7	1015°	1085°
330	Lithium	Li	7.00	0.534[20°]	186°	1400°
331	Carbonate	Li_2CO_3	74.00	2.111	618°–710°	
332	Chloride	LiCl	42.46	1.998–2.074	491°–600°	
333	Hydroxide	LiOH	24.01		red heat	
334	Iodide	LiI	133.92	4.063[25]	330°–446°	
335	Nitrate	$LiNO_3$	69.07	2.334–2.442	253°–264°	
336	Oxide	Li_2O	30.00	2.102		
337	Sulphate	Li_2SO_4	110.07	2.210[15°]	818°–853°	
338	Magnesium	Mg	24.32	1.69–1.75	632.6°	2200°

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot water	Alcohol, acids, alkalies, etc.	
290	0.0182[21°]	0.0925[55°]	soluble KI, CS_2, alcohol $CHCl_3$	gray black
291	insoluble	insoluble	soluble acids; insoluble alkalies	cubical or regular
292	insoluble	insoluble	soluble acids; insoluble alkalies	.....
293	insoluble	insoluble	soluble acids; insoluble alkalies	.....
294	insoluble	insoluble	soluble acids; insoluble alkalies	.....
295	insoluble	insoluble	soluble acids; insoluble alkalies	.....
296	insoluble	insoluble	soluble acids; insoluble alkalies	.....
297	insoluble	.....	soluble HNO_3, hot conc. H_2SO_4	gray crystals
298	insoluble	insoluble	soluble acids	regular
299	insoluble	.....	s. soluble HCl	gray crystals
300	0.000049	.....	insoluble dilute acids	yellow, reg. or shombic
301	decomp.	.....	soluble HCl, H_2SO_4	.....
302	.....	.....	.....	.....
303	insoluble	insoluble	soluble HNO_3, hot concentrated	regular or monoclinic
304	45.64[15°]	200[100°]	insoluble alcohol	monoclinic
305	v. soluble	.....	s. soluble alcohol	.....
306	v. soluble	.....	v. soluble alcohol	needles
307	5.55	18.2	soluble alcohol	needles
308	0.00198	decomp.	insoluble alcohol	rhombic
309	insoluble	insoluble	0.02 CO_2 aqua	amorphous
310	0.673[0°]	3.34[100°]	0.09 dilute HCl, insoluble alcohol	rhombic
311	.000021[8°]	insoluble	soluble acids, alkalies; insoluble	yellow monoclinic
312	insoluble	insoluble	soluble acids, alkalies	red crystals
313	s. soluble	s. soluble	soluble alkalies	.....
314	0.014	.....	soluble alkalies	regular
315	0.044[0°]	0.436[160°]	insoluble alcohol, soluble KI	yellow hexagonal
316	39[0°]	138.9[100°]	8.77[22°] alcohol	octahedral
317	0.00018	.....	insoluble alcohol, soluble HNO_3	.....
318	0.013–02	.....	soluble alkalies, lead	yellow rhombic
319	0.0013	insoluble	acetate NH_4Cl, $CaCl_2$	red hexagonal
320	insoluble	insoluble	$SrCl_2$	amorphous
321	insoluble	.....	decomposes by acids, alkalies	grayish black
322	insoluble	decomp.	decomposes	reddish yellow
323	insoluble	.....	soluble glacial $H.C_2H_3O_2$	scarlet
324	insoluble	insoluble	insoluble alcohol; soluble glacial H	brown hexagonal
325	0.000014[20°]	s. soluble	sol. HNO_3; insol. $H.C_2H_3O_2$	.....
326	0.0042[20°]	s. soluble	soluble conc. H_2SO_4HCl NH_4 salts insoluble alcohol	rhombic
327	s. soluble	.....	s. soluble H_2SO_4	crystalline
328	0.0044°	s. soluble	s. soluble H_2SO_4	.....
329	0.0001	insoluble	soluble conc.; acids insoluble KOH	black regular
330	decomp.	decomp.	soluble acids	silvery
331	1.539[0°]	0.728[100°]	insoluble alcohol	prisms
332	63.70°	129[96°]	2.475[25°] alcohol soluble ether	octahedral
333	12.70°	17.5[100°]	s. soluble alcohol	crystalline
334	151[0°]	476[99°]	.....	crystalline
335	48.30°	227.3[100°]	soluble alcohol	rhombohedral
336	5.22[0°]	6.26[100°]	.....	crystalline
337	35.34[0°]	29.24[100°]	insoluble 80% alcohol	.....
338	insoluble	s. decomp.	soluble acid, NH_4 salts	.....

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
	Magnesium					
339	Ammon. chloride	$MgCl_2.NH_4Cl.6H_2O$	256.84	1.456	.....	.....
340	Ammon. phosphate	$MgNH_4PO_4.6H_2O$	245.16	$1.71^{15°}$	decomp.	.....
341	Ammon. sulphate	$MgSO_4.(NH_4)_2SO_4.6H_2O$	360.64	$1.723^{\frac{20}{4}}$	.....	.....
342	Carbonate	$MgCO_3$	84.32	3.04	dec. 350°	.....
343	Carbonate basic	$4MgCO_3.Mg(OH)_2.5H_2O$	485.70	2.18	.....	.....
344	Chloride	$MgCl_2$	95.24	2.177	708°	red heat
345	Chloride	$MgCl_2.6H_2O$	203.34	1.569^{17}	$2H_2O$, 100°	decomp.
346	Hydroxide	$Mg(OH)_2$	58.34	$2.36^{15°}$	decomp.	.....
347	Nitrate	$Mg(NO_3)_2 6H_2O$	256.50	1.464	90°	.....
348	Oxalate	$MgC_2O_4.2H_2O$	148.35	.....	decomp.	.....
349	Oxide	MgO	40.32	3.22–3.654	1890°–1940°	.....
350	Phosphate pyro-	$Mg_2P_2O_7$	222.64	2.40	.....	.....
351	Potassium chloride	$MgCl_2.KCl.6H_2O$	277.90	.....	.....	.....
352	Potassium sulphate	$MgSO_4.K_2SO_4.6H_2O$	402.76	$2.0277^{\frac{20}{4}}$	.....	.....
353	Sulphate	$MgSO_4$	120.39	2.65	.....	.....
354	Sulphate	$MgSO_4.7H_2O$	246.50	$1.678^{16°}$	.....	.....
355	Manganese	Mn	54.93	7.42	1207°	.....
356	Acetate	$Mn(C_2H_3O_2)_2.4H_2O$	245.04	1.6	.....	.....
357	Ammon. phosphate	$NH_4MnPO_4.H_2O$	185.99	.....	.....	.....
358	Carbide	Mn_3C	176.79	$6.89^{17°}$	.....	.....
359	Carbonate	$MnCO_3$	114.93	3.125–3 66	decomp.	.....
360	Chloride	$MnCl_2$	125.85	2.478	red heat	.....
361	Chloride	$MnCl_2.4H_2O$	197.91	1.913	87.5°	106°
362	Chloride per-	$MnCl_4$	196.77	.....	.....	.....
363	Ferrocyanide	$Mn_2Fe(CN)_6.7H_2O$	447.88	.....	.....	.....
364	Hydroxide (ous)	$Mn(OH)_2$	88.95	3.258	decomp.	.....
365	Hydroxide (ic)	$Mn_2O_3H_2O$	175.88	4.335	decomp.	.....
366	Nitrate	$Mn(NO_3)_2 6H_2O$	287.05	1.82	25.8°	129.4°
367	Oxalate	$MnC_2O_4.2\frac{1}{2}H_2O$	187 97	$2.453^{20°}$	dec. 150°	.....
368	Oxide (ous)	MnO	70 93	5.09–5.18	white heat	.....
369	Oxide (ic)	Mn_2O_3	157.86	4.325–4.82	.....	.....
370	Oxide di-	MnO_2	86.93	5.026	decomp.	.....
371	Oxide tri-	Mn_3O_4	102.93	.....	decomp.	.....
372	Oxide hept-	Mn_2O_7	221.86	1.84	−20°	explodes
373	Pyrophosphate	$Mn_2P_2O_7$	283.86	$3.5847^{20°}$	.....	.....
374	Sulphate (ic)	$Mn_2(SO_4)_3$	398 07	.....	decomp.	160°
375	Sulphate (ous)	$MnSO_4H_2O$	151.09	2.954	decomp.	.....
376	Sulphide (ic)	MnS_2	119.07	0.463	decomp.	.....
377	Sulphide (ous)	MnS	87.00	3.63^{17}_{17}	decomp.	.....
378	Sulphide (ous)	MnS	87.00	3.55^{17}_{17}	decomp.	.....
379	Manganomanganic oxide	Mn_3O_4	228.79	4.33-4.9	infustble	.....
380	Mercuridiammonium chloride infusible white ppt.	$NHg_2Cl.NH_4Cl$	502.97	5.700	volatile	.....
381	Mercuro ammonium chloride	NH_2HgCl	252.49	.....	decomp.	.....

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot water	Alcohol, acids, alkalies, etc.	
339	16.7	.....	.....	.....
340	0 01322	.....	soluble acids; insoluble alcohol	tetragonal
341	13.49°	68.87⁷⁵	.....	prisms
342	0.0106	.....	soluble acids, 2.21 CO_2 aqua	hexag. rhombohedral
343	0.04	0.011	soluble acids, NH_4 salts	.....
344	52.2°	65.87²⁰°	50 alcohol	crystalline
345	167.0	367.0	50 alcohol	monoclinic
346	0.0009	.....	soluble NH_4 salts	rhombohedral
347	200.0	.....	soluble alcohol	monoclinic
348	0.07¹⁶	0.08¹⁰⁰°	soluble alkalies oxalates, acids	.....
349	0.00062	.....	soluble acids, NH_4 salts	regular or hexagonal
350	insoluble	insoluble	soluble acids, insoluble alcohol	.....
351	.....	.....	.....	hexagonal
352	19.26²⁰°	81.70⁷⁵°	.....	.....
353	26 9°°	73.8¹⁰⁰°	soluble alcohol	.....
354	76.9°°	671.2¹⁰⁰°	soluble alcohol	tetragonal
355	decomp.	decomp.	soluble dilute acids	reddish clinic
356	3.0	.....	soluble alcohol	pale red monoclinic
357	0.0031	0.05	insoluble alcohol, NH_4 salts	.....
358	decomp.	decomp.	soluble acids	tetrahedral
359	0.013	insoluble	0.028, CO_2 aqua sol. dilute acids	rose col. rhombohedral
360	62.16¹⁰°	123.8¹⁰⁰·⁵°	soluble alcohol; insoluble ether	.....
361	151⁸°	.....	soluble alcohol; insoluble ether	rose col. monoclinic
362	soluble	soluble	soluble ether	green
363	insoluble	.....	soluble HCl; insoluble NH_4 salts	.....
364	insoluble	insoluble	soluble acids NH_4 salts; insoluble	hexagonal
365	insoluble	insoluble	soluble hot concentrated H_2SO_4	tetragonal
366	426.4°	.....	v. soluble alcohol	.....
367	0.05	0.08¹⁰⁰°	soluble dilute acids	.....
368	insoluble	insoluble	soluble acids, NH_4Cl	grass green regular
369	insoluble	insoluble	soluble acids	black regular
370	insoluble	insoluble	soluble HCl	.....
371	soluble	decomp.	soluble concentrated H_2SO_4	reddish
372	v. soluble	decomp.	soluble concentrated H_2SO_4	dark red oil
373	insoluble	.....	soluble acids	.....
374	deliques	decomp.	soluble conc., HCl, diluted H_2SO_4	green crystals
375	53.2°	67⁷⁵°	soluble alcohol; insoluble ether	.....
376	insoluble	insoluble	decomposes by HCl	black regular
377	0.00047	insoluble	insoluble $(NH_4)_2$; sol. dilute acids	green crystals
378	0.0006	insoluble	insoluble $(NH_4)_2S$; sol. dilute acids	red
379	insoluble	insoluble	soluble hot HCl	brown tetragonal
380	0.14	decomp.	insoluble alcohol; soluble acids	.....
381	insoluble	.....	.....	black

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
382	Mercuric acetate	$Hg(C_2H_3O_2)_2$	318.05	$3.2544^{22°}$		
383	Carbonate basic	$2HgO.HgCO_3$	692.00			
384	Chloride	$HgCl_2$	270.92	5.32–5.46	265°	303°–307°
385	Fulminate	$HgC_2N_2O_2$	284.02	4.42	explodes	
386	Hydrate	$Hg(OH)_2$	234.02		H_2O, 175	
387	Iodide red	HgI_2	453.84	6.2–6.32	241°–257°	349°
388	Iodide yellow	HgI_2	453.84	5.91–6.06	241°	349°
389	Nitrate	$Hg(NO_3)_2$. $2H_2O$	342.04		decomp.	
390	Oxide	HgO	216.00	11.00–11.29	decomp.	
391	Phosphate	$Hg_3(PO_4)_2$	790.00			
392	Potassium iodide	$2HgI_2.2KI.$ $3H_2O$	1293.9	$4.289^{23.5°}$		
393	Sulphate	$HgSO_4$	296.07	6.466	dec. red ht.	
394	Sulphate basic	$HgSO_4.2HgO$	728.07	6.44		
395	Sulphide	HgS	232.07	7.55–7.70		
396	Sulphide	HgS	232.07	8.06–8.12	sublimes	
397	Mercurous carbonate	Hg_2CO_3	460.00		dec. 130°	
398	Chloride	HgCl	235.46	6.993–7.18	sublimes at 400°–500°	
399	Chloride	HgCl	235.46	6.482	400°–500°	
400	Iodide	HgI	326.92	7.70	290°	310°
401	Nitrate	$HgNO_3.2H_2O$	298.04	4.78	decomp.	
402	Oxide	Hg_2O	416.00	8.95–10.69	decomp.	
403	Sulphate	Hg_2SO_4	496.07	7.56	melts	decomp.
404	Sulphide	Hg_2S	432.07		dec. at 0	
405	Trintride	HgN_3	242.03		explodes	
406	Mercury	Hg	200.00	13.5953^{0}	−38.85°	357.33°
407	Molybdenum	Mo	96.00	8.6–9.01		
408	Oxide di-	MoO_2	128.00	6.44		
409	Oxide sesqui-	Mo_2O_3	240.00			
410	Oxide tri-	MoO_3	144.00	$4.392^{0°}$	759°	sublimes
411	Sulphide di-	MoS_2	160.14	$4.80^{14°}$	oxidizes	
412	Sulphide di-	MoS_2 (Mineral)	160.14	4.44–4.80		
413	Sulphide tri-	MoS_3	192.21		loses S	
414	Sulphide tetra-	MoS_4	224.28		oxidizes.	
415	Molybdic acid	H_2MoO_4	162.02			
416	Molybdic acid	$H_2MoO_4.H_2O$	180.03	3.124	H_2O, 70°	
417	Nickel	Ni	58.68	8.6–8.93	1435°	
418	Acetate	$Ni(C_2H_3O_2)_2$	176.73	1.799	decomp.	
419	Ammon. chloride	$NiCl_2.NH_4$ $Cl.6H_2O$	291.24	1.645		
420	Ammon. sulphate	$NiSO_4.(NH_4)_2$ $SO_4.6H_2O$	395.00	$1.929^{2°}_{4°}$		
421	Carbonate	$NiCO_3$	118.68		decomp.	
422	Chloride	$NiCl_2$	129.60	2.56	sublimes	
423	Chloride	$NiCl_2.6H_2O$	237.70			
424	Chloride ammonia	$NiCl_2.6NH_3$	231.74			
425	Cyanide	$Ni(CN)_2.4H_2O$	110.72		$4H_2O$, 200°	decomp.
426	Hydroxide (ous)	$4Ni(OH)_2.H_2O$	388.80	4.36	decomp.	
427	Hydroxide (ic.)	$Ni(OH)_3$	109.70		decomp.	
428	Iodide ammonia	$NiI_2.6NH_3$	414.66	2.101	decomp.	
429	Nitrate	$Ni(NO_3)_2.6H_2O$	290.80	$2.065^{14°}$	56.7°	136.7°
430	Nitrate ammonia	$Ni(NO_3)_2.$ $4NH_3.2H_2O.$	286.83			
431	Oxide mon-	NiO	74.68	6.6–6.8		
432	Oxide sesqui-	Ni_2O_3	165.36	$4.84^{18°}$		
433	Potassium cyanide	$Ni(CN)_2$ $2KCN.H_2O.$	258.94	1.875	H_2O, 100°	
434	Sulphate	$NiSO_4$	154.75	$3.418^{15°}$		

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
Cold water	Hot water	Alcohol, acids, alkalies, etc.	
25^{100}	100$^{100°}$	soluble alcohol	micaceous
insoluble	.....	.....	brown scales red
5.73$^{0°}$	53.96$^{100°}$	43.5 alcohol, 33 ether	rhombic
s. soluble	soluble	soluble alcohol, NH_3	octahedral
insoluble	.....	soluble acids HNO	.....
0.0004$^{17.5°}$	.....	1.186$^{18°}$ alcohol; soluble	red tetragonal
insoluble	.....	$Na_2S_2O_3$ alkalies, salts	yellow rhombic
v. soluble	decomp.	soluble HNO_3, insoluble alcohol	crystalline
0.0051525$^{0°}$	0.0395$^{100°}$	insoluble alcohol; soluble acid	plates or red
insoluble	s. soluble	soluble acid, NH_4Cl.; insol. alcohol	.....
decomp.	.....	soluble alcohol, ether, KI	.....
decomp.	.....	soluble acids, insoluble alcohol	.....
0.002	.....	soluble acids, insoluble alcohol	yellow
0.0025	.....	soluble Na_2S; insoluble HNO_3	black amorphous
insoluble	insoluble	soluble aqua regia	rhombohedral or
insoluble	decomp.	soluble NH_4Cl	black or yellow
0.00031	0.01	insol. al., ether; sol. Hg $(NO_3)_2$ aq.r.	rhombic
0.00031	0.01	s. soluble hot, HNO_3	tetragonal
0.0417	.....	soluble KI; insoluble alcohol	yellow tetragonal
v. soluble	decomp.	.....	monoclinic
insoluble	insoluble	soluble glacial, $HC_2H_3O_2$ insoluble	black
0.2	0.33	soluble $H_2SO_4HNO_3$	monoclinic
insoluble	.....	insoluble acids, $(NH_4)_2S$	black
insoluble	.....	.....	crystalline
insoluble	insoluble	soluble HNO_3 concentrated H_2SO_4	silvery octahedral
insoluble	insoluble	soluble HNO_3 concentrated H_2SO_4	gray
insoluble	.....	s. soluble, conc. H_2SO_4, insoluble	red prisms
insoluble	.....	insoluble acids, alkalies	black to yellow
0.107$^{18°}$	1.705$^{70°}$	soluble acids, NH_3 aqua	rhombic
insoluble	.....	soluble H_2SO_4, aqua regia	black powder
insoluble	.....	.....	.....
s. soluble	soluble	soluble alkalies, sulphides	red brown
insoluble	.....	soluble alkalies, sulphide	brown powder
s. soluble	.....	soluble NH_3 aqua	needles
0.133$^{18°}$	2.18$^{70°}$	soluble acids, NH_3 aqua, NH	yellow monoclinic
insoluble	insoluble	soluble diluted HNO_3; s. soluble	.....
16.6	.....	insoluble alcohol	apple green prisms
v. soluble	.....	.....	green rhombic
2.5$^{2.4°}$	39.$^{28°}$	s. soluble $(NH_4)_2SO_4$ aqua	green crystals
insoluble	insoluble	insoluble acids	greenish rhombic
53.8$^{0°}$	87.6$^{100°}$	soluble alcohol, NH_3 aqua	yellow scales
179.3$^{0°}$	599$^{100°}$	v. soluble alcohol	green hexagonal
soluble	decomp.	insoluble alcohol; soluble NH_3 aqua	.....
insoluble	insoluble	soluble KCN; insoluble dil. KCl	apple green
insoluble	.....	sol. acid, NH_3 aqua, insol. alkalies	pale green
insoluble	insoluble	soluble acids, NH_3 aqua	black
decomp.	.....	soluble NH_3 aqua	.....
238.5$^{0°}$	.....	soluble alcohol NH_3 aqua	green monoclinic
v. soluble	.....	insoluble alcohol	.....
insoluble	.....	soluble acids NH_3 aqua	green octahedral
insoluble	.....	soluble HCl, NH_3 aqua	black
soluble	.....	decomposes by acids	red yellow
29.3$^{0°}$	83.7$^{100°}$	insoluble alcohol, ether	yellow monocl. regular

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
435	Nickel sulphate	$NiSO_4.7H_2O$	280.86	1.98	98°-100°	
436	Sulphide monoclinic	NiS	90.75	4 60		
437	Sulphide sub-	Ni_2S	149.43	5.52		
438	Nickelo-nickelic oxide	Ni_3O_4	240 04			
439	Nitric acid	HNO_3	63.02	1.530^{15}_{15}	41.3°	86°
440	Nitrogen	N_2	28.02	.96737 A	−210.5°	−195 5°
441	Oxide mon- (nitrous)	N_2O	44.02	.937°1.530A	−102.3°	89 8°
442	Oxide di- (nitric)	$NO(N_2O_2)$	30.01	1.0367 A	150°	149.9°
443	Oxide tri-	N_2O_3	76.02	$1.447-2^{0}$	−111°	3.5°
444	Oxide tetr-	$NO_2(N_2O_4)$	46.01	1.4903^{0}	10 1°	21 6°
445	Oxide pent-	N_2O_5	108.02	$1.642^{18.5}$	30°	45°-50
446	Oxalic Acid	$H_2C_2O_4.2H_2O$	126.05	$1.653^{18.5°}$	98°	
447	Oxygen	O_2	32.00	1.10535 A	−230°	182 7°
448	Ozone	O_3	48.00	1.658 A	dec. 270°	−119°
449	Perchloric acid	$HClO_4$	100.47	$1.764^{2.5}_{4}$		39°
450	Periodic acid	$HIO_4.2H_2O$	227.96		130°	734°
451	Permanganic acid	$HMnO_4$	119.96			
452	Phosphine	PH_3	34 02	1.185 A	−133.5°	−85°
453	Phosphine liquid	P_2H_4	66.03	1.007-016	−10°	57°-58°
454	Phosphine solid	$(P_4H_2)_3$	378.05		burns 200°	
455	Phosphoric acid					
	Hypo-	$H_4P_2O_6$	162.03		55°	dec. 70°
456	Meta	HPO_3	80.01			
457	Ortho-	H_3PO_4	98.02	$1.884^{18.2°}$	38.6°	
458	Pyro-	$H_4P_2O_7$	178.03		61°	−10°
459	Phosphorous acid					
	Hypo	H_3PO_2	66 02	$1.493^{18.2°}$	26.5°	decomp.
460	Ortho-	H_3PO_3	82.02	$1.651^{21.2°}$	70.1°	
461	Pyro-	$H_4P_2O_5$	146.03		38°	
462	Phosphorous yellow	P_4	124 00	$1.831^{18°}$	44.2°	290°
463	Phosphorous red	P_4	124.00	$2.296^{16°}$	350° (vel.)	
464	Phosphorus					
	Chloride tri-	PCl_3	137.38	1.61283	111.8°	76°
465	Chloride penta-	PCl_5	208.30	$3.60^{200°}$ D	148°	160°-16
466	Oxide tri-	P_4O_6	220.00	2.135^{0}_{4}	23.5°	173 1°
467	Oxide tetr-	P_2O_4	126.00	2.537^{226}	100°	180°
468	Oxide pent-	P_2O_5	142 00	2.387		
469	Oxychloride	$POCl_3$	153.38	1.71163^{0}_{4}	1.5°	107.2°
470	Platinic acid chlor.	$H_2PtCl_6.6H_2O$	517.87	2.431	decomp.	
471	Platinum	Pt	195.00	$21.483^{17.6°}$	1753°	
472	Chloride di-	$PtCl_2$	265.92	5.871^{0}		
473	Chloride tetra-	$PtCl_4$	336 84		decomp.	
474	Hydroxide (ous)	$Pt(OH)_2$	229.02			
475	Sulphide mono-	PtS	227.07	8.807	decomp.	
476	Sulphide di-	PtS_2	259.14	5.27	decomp.	
477	Sulphide sesqui-	Pt_2S_3	486.21	5.52		
478	Sulphate	$Pt(SO_4)_2.4H_2O$	459 20			
479	Potassium	K	39 10	$0.875^{13°}$	62.5°	757
480	Acetate	$KC_2H_3O_2$	98.12			
481	Aluminate	$K_2Al_2O_4.3H_2O$	250 45			
482	Antimonate	$KSbO_3$	207.30			
483	Antimonyl tartrate	$KSbOC_4H_4O_6$ $\frac{1}{2}H_2O$	332 34	2.6	$\frac{1}{2}H_2O$, 100°	
484	Arsenate	K_3AsO_4	256.30			
485	Arsenate	K_2HAsO_4	218.21			
486	Bromate	$KBrO_3$	167.02	$3.271^{17.15}_{17.15}$	434°	decomp
487	Bromide	KBr	119.02	$2.756^{4°}$	710°-750°	
488	Carbonate	K_2CO_3	138.20	$2.3312^{17°}$	860°-898°	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
Cold water	Hot water	Alcohol, acids, alkalies, etc.	
75.6$^{15.5°}$	475.8$^{100°}$	v. soluble alcohol	green rhombic
0.00036	decomp.	soluble HNO_3 aqua regia	black hexagonal
insoluble	.....	soluble HNO	yellow crystals
insoluble	.....	soluble acids	gray
.....	.....	.....	.....
2.348 cc.$^{0°}$	1.542 cc. $^{20°}$	s. soluble alcohol	crystals
130.52$^{0°}$	60.82$^{24°}$	soluble alcohol, conc. H_2SO_4	.....
7.3 cc. $^{0°}$	0.0 cc. $^{100°}$	3.5 cc. concentrated H_2SO_4	.....
soluble	.....	soluble $HNO_3H_2SO_4$ ether	blue solid or red
soluble	.....	soluble CS_2CHCl_3, concentrated	reddish yellow
soluble	.....	.....	rhombic
4.9$^{0°}$	120.$^{78°}$	soluble alcohol	crystalline
4.89 cc. $^{5°}$	2.61 cc. 30°	sol. melted Ag.; s. sol. alcohol	.....
0.88	.....	oil of turpentine and cinnamon	.....
soluble	.....	.....	oily
v. soluble	.....	soluble alcohol, ether	monoclinic
soluble	decomp.	.....	.....
s. soluble	insoluble	soluble alcohol, ether, Cu_2Cl_2	.....
insoluble	.....	soluble alcohol, turpentine	.....
insoluble	insoluble	insoluble alcohol	yellow
.....	.....	.....	.....
soluble	.....	.....	crystals
soluble	soluble	.....	glassy
v. soluble	.....	soluble alcohol	rhombic
v. soluble	decomp.	v. soluble	needles
.....	.....	.....	.....
.....	.....	.....	tablets
.....	.....	.....	crystalline
decomp.	.....	.....	needles
0.00033	s. soluble	1.5$^{0°}$, 10$^{81°}$; benzol, 0.4; alcohol, 1000; CS_2, 4300; 2^{35} ether; sol. alk.	yellow regular
insoluble	insoluble	insoluble ether, CS_2; sol. alkalies	red hexag. rhomboh.
.....	.....	.....	.....
decomp.	decomp.	soluble CS_2 ether, $CHCl_3$	.....
decomp.	.....	soluble CS_2, C_4H_3COCl	yellow rhombic
soluble	decomp.	soluble CS_2, ether, $CHCl_3$	liquid or monoclinic
soluble	.....	.....	orthorhombic
v. soluble	.....	soluble concentrated H_2SO_4	plates
decomp.	decomp.	decomposes	tablets
v. soluble	v. soluble	soluble alcohol, ether	red brown
insoluble	insoluble	soluble aqua regia, fused alkalies	grayish
insoluble	insoluble	soluble HCl, NH_4 aqua	brown
v. soluble	.....	soluble alcohol, ether	brown
insoluble	insoluble	soluble HCl, HBr, SO_2 aqua, alkalies	black
insoluble	.....	insoluble acids, soluble $(NH_4)_2S$	black needles
insoluble	.....	soluble $(NH_4)_2S$, aqua regia	black or gray
insoluble	.....	insoluble acids; soluble aqua regia	steel gray
soluble	decomp.	soluble acids, alcohol, ether	yellow plates
decomp.	decomp.	soluble acids, alcohol, mercury	.....
1881$^{0°}$	492$^{62°}$	33 alcohol; insoluble ether	.....
v. soluble	.....	insoluble alcohol; soluble alkalies	crystals
insoluble	s. soluble	soluble warm KOH	crystals
.....	.....	.....	.....
5$^{8°}$	52$^{100°}$	insoluble alcohol	octahedral
18.87	v. soluble	4 alcohol	needles
soluble	.....	.....	.....
3.1$^{0°}$	50$^{100°}$	insoluble alcohol	rhombohedral
53.48$^{0°}$	102.04$^{100°}$	s. soluble alcohol, ether	regular
89.4$^{0°}$	156$^{100°}$	insoluble alcohol	.....

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
489	Potassium Carbonate	$2K_2CO_3.3H_2O$	330.45			
490	Chlorate	$KClO_3$	122.56	$2.344^{17°}$	370°	
491	Chloride	KCl	74.56	1.9942^{25}	772°	subl. w.
492	Chromate	K_2CrO_4	194.30	2.7214^{5}	971°	
493	Cobaltinitrite	$2Co(NO_2)_3.$ $6KNO_2.3H_2O$	958.71		dec. 200°	
494	Cobaltocyanide	$K_4Co(CN)_6$	371.43			
495	Cyanide	KCN	65.11	$1.52^{16°}$	red heat	red heat
496	Dichromate	$K_2Cr_2O_7$	294.40	$2.6924°$	396°	dec. 1000
497	Ferricyanide	$K_3Fe(CN)_6$	329.21	$1.8109^{17°}$	decomp.	
498	Ferrocyanide	$K_4Fe(CN)_6.$ $3H_2O$	422.36	$1.8533^{17°}$		
499	Formate	$KCHO_2$	84.11	1.908	150°	decomp.
500	Hydrosulphide	KSH	72.18	2.	decomp.	
501	Hydroxide	KOH	56.11	2.044	red heat	subl. w.
502	Iodate	KIO_3	214.02	$3.975^{15°}$	560°	
503	Iodate acid	$KH(IO_3)_2$	389 95			
504	Iodide	KI	166.02	$3.043^{24°3}$	614°-723°	
505	Iodide tri-	KI_3	419.86	$3.498^{15°}$	45°	
506	Magnesium chloride (carnallite)	$MgCl_2.KCl.$ $6H_2O$	277.90	1.618		
507	Manganate	K_2MnO_4	197.13		dec. 190°	
508	Nitrate	KNO_3	101.11	2.1^{0}	333°	decomp.
509	Nitrite	KNO_2	85.11	$1.195^{25°}$		
510	Nitroprusside	$K_2Fe(CN)_5.$ $NO\ 2H_2O$	330.14			
511	Oxalate	$K_2C_2O_4.H_2O$	184.22	2.08	decomp.	
512	Oxalate tetr-	$KH_3(C_2O_4)_2.$ $2H_2O$	254.16	1.836	decomp.	
513	Oxide	K_2O	94.20	2.32^{0}_{4}	red heat	
514	Oxide per-	K_2O_4	142.20		red heat	decomp.
515	Permanganate	$KMnO_4$	158 03	2.7032^{20}_{4}	dec. 240°	
516	Persulphate	$K_2S_2O_8$	270.34		dec. 100°	
517	Phosphate ortho-	K_3PO_4	212.30			
518	Phosphate hydrogen	K_2HPO_4	174.21		decomp.	
519	Phosphate Dihydrogen	KH_2PO_4	136.12	2.3382^{0}_{4}	96°	H_2O, 40
520	Phosphate pyro-	$K_4P_2O_7.3H_2O$	384. 45	2.33	$3H_2O$, 300°	
521	Phosphate meta-	$K_4P_4O_{12}.2H_2O$	472.40	$2.2641^{4-5°}$	$2H_2O$, 100°	
522	Phosphite	K_2HPO_3	158.21		decomp.	
523	Silicate	K_2SiO_3	154.50			
524	Sulphate acid	$KHSO_4$	136.18	2.245	200°	decomp
525	Sulphide mono-	K_2S	110.27	2.13		
526	Tartrate	$K_2C_4H_4O_6.$ $\frac{1}{2}H_2O$	235.24	1.975		
527	Tartrate acid	$KHC_4H_4O_6$	188.14	1.956		
528	Radium bromide	$RaBr_2$	380.24			
529	Chloride	$RaCl_2$	296.9		1650°	
530	Silicic acid meta-	H_2SiO_3	78.32	1.813		
531	Silicic acid ortho-	H_4SiO_4	96.33	$1.576^{170°}$		
532	Silicon cryst.	Si	28.3	$2.491^{0°}$	1200°	3500
533	Graphitic	Si	28.3	2.00-2.50		3500
534	Amorphous	Si	28.3	2.00		3500
535	Carbide	SiC	40.30	$3.12^{15°}$		
536	Chloride tetra-	$SiCl_4$	170.14	1.5243	−89°	59.6
537	Fluoride	SiF_4	104.30	3.57 Å	−77°	−65
538	Hydride	SiH_4	32.33			
539	Oxide di- amorphous	SiO_2	60.30	$2.20^{15.6°}$	1600°	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot water	Alcohol, acids, alkalies, etc.	
489	129.4°	268.3$^{100°}$	.....	monoclinic
490	3.3°	60$^{104.8}$	0.833 alcohol; soluble alkalies	monoclinic
491	28.5°	56.6$^{100°}$	soluble alcohol, alkalies	regular
492	61.5°	81.8$^{106.1°}$	insoluble alcohol	yellow rhombic
493	0.09°	s. soluble	insoluble alcohol, ether	yellow tetragonal
494	soluble	.....	insoluble alcohol, ether	amethyst needles
495	v. soluble	122.2$^{103.3°}$	soluble glycerine, alcohol	octahedral
496	4.9°	102$^{100°}$	insoluble alcohol	red tri-or monoclinic
497	33$^{4.5°}$	77.5$^{100°}$	s. soluble alcohol	red monoclinic
498	27.8$^{12.2°}$	90.6$^{96.3°}$	insoluble alcohol	yellow monoclinic
499	331$^{18°}$	657$^{90°}$	.....	rhombic
500	soluble	soluble	v. soluble alcohol	yellow rhombic
501	107$^{15°}$	178$^{100°}$	v. soluble alcohol, ether	rhombohedral ($2H_2O$)
502	4.74$^{0°}$	32.3$^{100°}$	insoluble alcohol; soluble KI	regular
503	1.33$^{15°}$	.....	.....	rhombic or monoclinic
504	126.1°	205.6$^{100.7°}$	14.28 alcohol; soluble ether	regular
505	v. soluble	.....	soluble alcohol, KI	dark blue needles
506	64.5$^{18.75}$	decomp.	decomposes by alcohol	hexagonal
507	decomp.	.....	soluble KOH	dark green rhombic.
508	13.3°	247$^{100°}$	insoluble alcohol, ether	.....
509	300$^{15.5°}$	.....	insoluble alcohol	prismatic
510	100$^{15°}$	.....	soluble alcohol	red monoclinic
511	33$^{21°}$	.....	.....	yellowish plates
512	1.8$^{23°}$	.....	.....	triclinic
513	v. soluble	v. soluble	soluble alcohol, ether	gray octahedral
514	decomp.	.....	decomposes by alcohol	yellowish leaflets
515	2.83°	32.35$^{75°}$	soluble concentrated H_2SO_4	dark red rhombic.
516	0.564$^{0°}$	4.08$^{60°}$	insoluble alcohol	prismatic
517	s. soluble	soluble	insoluble alcohol	rhombic
518	v. soluble	v. soluble	v. soluble alcohol	.....
519	25$^{7°}$	.....	insoluble alcohol	tetragonal
520	soluble	v. soluble	insoluble alcohol	.....
521	s. soluble	.....	soluble acids	amorphous
522	v. soluble	.....	insoluble alcohol	.....
523	soluble	.....	insoluble alcohol	.....
524	36.3°	121.6$^{100°}$	decomposes by alcohol	monoclinic
525	soluble	v. soluble	sol. alcohol, glycerine; insol. ether	brown crystals
526	133$^{20°}$	153$^{22°}$	s. soluble alcohol	monoclinic
527	0.37$^{0°}$	6 $^{100°}$	insol. alcohol, $H.C_2H_3O_2$; soluble	rhombic
528	soluble	soluble	soluble alcohol	.....
529	.....	.....	.....	yellowish regular
530	insoluble	.....	soluble alkalies; insoluble NH_4Cl	amorphous
531	s. soluble	.....	soluble alkalies; insoluble NH_4Cl	amorphous
532	insoluble	insoluble	insoluble HF; soluble HNO_3	gray octahedral
533	insoluble	insoluble	insoluble HF; soluble HNO_3	crystalline
534	insoluble	insoluble	soluble HF, KOH	brown amorphous
535	insoluble	insoluble	insoluble acids	rhombic plates
536	decomp.	.....	decomposes by alcohol	yellow
537	decomp.	.....	soluble alcohol, ether, HNO_3	gas
538	insoluble	.....	decomposes by KOH	.....
539	insoluble	.....	soluble hot alkalies, HF	amorphous

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
540	Silicon Oxide di cryst.	SiO_2	60.30	2.318–2.654	1750°	
541	Sulphide	SiS_2	92.44			v hite hea
542	Silver	Ag	107.88	10.53	961.5°	2050°
543	Silver	Ag	107.88		955° in air	2050°
544	Acetate	$AgC_2H_3O_2$	166.90	3.259	decomp.	
545	Bromide	AgBr	187.80	6.473$^{25}_{25}$	427°	
546	Carbonate	Ag_2CO_3	275.76	6.08$^{15.5}_{5}$	dec. 200°	
547	Chloride	AgCl	143.34	5.561	451°–460°	
548	Chromate	Ag_2CrO_4	331.86	5.523		
549	Cyanide	AgCN	133.89	3.95	decomp.	
550	Iodide	AgI	234.80	5.675$^{25}_{25}$	526°–556°	
551	Nitrate	$AgNO_3$	169.89	4.352$^{18°}$	218°	decomp.
552	Oxide	Ag_2O	231.76	7.521	O, 300°–340°	
553	Oxide per-	AgO	123.88	5.474	dec. 100°	
554	Sulphate	Ag_2SO_4	311.83	5.40	654°–676°	decomp.
555	Sulphide	Ag_2S	247.83	6.85–7.32	812°	oxidizes
556	Sulphocyanate	AgCNS	165.96			
557	Sodium	Na	23.00	0.9735$^{15.5°}$	97.6°	877.5°
558	Acetate	$NaC_2H_3O_2$. $3H_2O$	136.7	1.4	58°	
559	Aluminate	$Na_2Al_2O_4$	164.2			
560	Ammonium phos.	$NaNH_4HPO_4$. $4H_2O$	209.11	1.554	decomp.	
561	Antimonate	$2NaSbO_3$ $7H_2O$	508.51			
562	Arsenite	Na_2HAsO_3	170.01	1.87		
563	Borate tetra-	$Na_2B_4O_7$	202.00	2.367	878°	
564	Borate tetra-borax	$Na_2B_4O_7.10H_2O$	382 16	1.694$^{17°}$	red heat	
565	Borate meta-	$Na_2B_2O_4$ $4H_2O$	204 06		57°	
566	Bromide	NaBr	102 92	2.95–3.08	757.7°	
567	Carbide	Na_2C_2	70 00	1.575$^{15°}$		700°
568	Carbonate	Na_2CO_3	106.00	2.43–2.51	849°	decomp.
569	Carbonate	$Na_2CO_3.10H_2O$	286.16	1.446$^{17°}$	34°	103°
570	Carbonate acid	$NaHCO_3$	84.01	2.19–2.22		
571	Chloride	NaCl	58.46	2.1741	801°	white he
572	Chromate	Na_2CrO_4. $10H_2O$	342.26	2.711$^{6°}$	19.92°	
573	Cyanide	NaCN	49.01			
574	Dichromate	$Na_2Cr_2O_7.2H_2O$	298.23	2.52$^{16°}$		
575	Hydroxide	NaOH	40.01	2.13	1098°	white h
576	Iodide	NaI	149.92	3.654$^{15.2°}$	603°–695°	
577	Nitrite	$NaNO_2$	69.01	2.157$^{25°}$	213°	
578	Nitroprusside	$Na_2Fe(CN)_5$ $NO.2H_2O$	297.84	1.6803$^{17°}$		
579	Oxide	Na_2O	62 00	2.25	red heat	sublime
580	Phosphate trisodium	$Na_3PO_4.12H_2O$	380.19	1.618–1.645	77°	
581	Phosphate disodium	Na_2HPO_4. $12H_2O$	358.2	1.5235$^{16°}$	35°	
582	Phosphate mono-	$NaH_2PO_4.H_2O$	138.03	2.040	$2H_2O$, 200°	
583	Phosphate meta-	$NaPO_3$	408 00	2.476	617°	
584	Phosphate pyro-	$Na_4P_2O_7.10H_2O$	446.16	1.824	anh. 970°	
585	Phosphate pyro-	$Na_2H_2P_2O_7$				
586	(disodium)	$6H_2O$	330.11	1.848		
587	Phosphite	$Na_2HPO_3.5H_2O$	216.09		53°	
588	Phosphite acid	$2NaH_2PO_3$. $5H_2O$	298 11		42°	
589	Silicate	Na_2SiO_3	122 30		10.07°	
590	Silicate water glass	$Na_2Si_4O_9$	303.20			
591	Stannate	Na_2SnO_3 $3H_2O$	267.05			
592	Sulphate	Na_2SO_4	142.07	2.671$^{20}_{4}$	888°	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
Cold water	Hot water	Alcohol, acids, alkalies, etc.	
insoluble	.....	insoluble alkalies; soluble HF	hexagonal prisms
decomp.	.....	sol. dil. alkalies; decomp. by alcohol	needles
insoluble	insoluble	soluble HNO_3, hot concentrated H_2SO_4; insoluble alkalies	.....
.....	.....	.....	.....
1.021°	2.52⁸⁰°	.....	laminae
0.000026²⁵°	0.00014¹⁰°	0.051 NH_3 aqua; soluble KCN	pale yellow octahedral
0.0031¹⁵°	0.05¹⁰°	sol. NH_3 aq., $Na_2S_2O_3$; insol. alcohol	.....
0.00152³⁰°	0.0022¹⁰⁰°	soluble conc. HCl, NH_3 aqua	regular
0.0028¹⁸°	.....	soluble acids, NH_3 aqua, KCN	dark red crystals
0.00002¹²⁵°	insoluble	soluble NH_3 aqua, KCN, HNO_3	white curdy
0.000035²¹°	.....	soluble KCN, $Na_2S_2O_3$, NaCl	yellow hexagonal
122⁰°	940¹⁰⁰°	66 alcohol, ether, glycerine	rhombic or hexagonal
0.0043°	.....	soluble NH_3 aqua, KCN	brown powder
insoluble	.....	soluble concentrated H_2SO_4, HNO_3	black octahedral
0.58	1.45¹⁰⁰°	soluble H_2SO_4, HNO_3, NH_3	rhombic
0.00002	.....	soluble concentrated H_2SO_4, HNO_3	gray black regular
0.00002125°	0.00023¹⁰°	insoluble dil. acids; soluble NH_3 aq.	curdy
decomp.	decomp.	insoluble benzol, kerosene	.....
.....	.....	.....	.....
286°	200	soluble alcohol, 2.1 soluble acids	monoclinic prisms
soluble	v. soluble	insoluble alcohol	amorphous
.....	.....	.....	.....
16.7	100	insoluble alcohol	monoclinic
.03¹²·2°	.....	s. soluble alcohol, NH_4 salts	octahedral
v. soluble	s. soluble	.....	.....
1.3¹°	52.5¹⁰⁰°	insoluble alcohol	.....
2.83²°	201.4¹⁰⁰°	insoluble acids; soluble glycerine	monoclinic
soluble	v. soluble	.....	monoclinic
79.5⁰°	114.9¹⁰⁰°	s. soluble alcohol	regular
decomp.	decomp.	soluble acids, decomposes alcohol	powder
7.1⁰°	45.4¹⁰⁰°	insoluble alcohol	.....
21.33⁰°	114.2³²°	insoluble alcohol	monoclinic
6.96⁰°	16.40⁶⁰°	insoluble alcohol	monoclinic
35.7⁰°	39¹⁰⁰°	insoluble conc. HCl; s. sol. alcohol	regular
.....	.....	.....	.....
87.36	.....	s. soluble alcohol	yellow triclinic
soluble	v. soluble	s. soluble alcohol	.....
239⁰°	1226⁹⁸°	.....	red triclinic
133.3¹⁸°	250⁹⁰°	v. soluble alcohol, ether, glycerine	.....
158.7⁰°	312.5¹⁰⁰°	v. soluble alcohol	regular
83.3²⁰°	v. soluble	0.31 ether; alcohol, 4.43	crystalline
.....	.....	.....	.....
40¹⁵°	.....	.....	red triclinic
decomp.	decomp.	decomposes alcohol	grayish
28.2¹⁵°	.....	.....	hexagonal
.....	.....	.....	.....
6.3⁰°	.....	insoluble alcohol	rhombic
v. soluble	.....	insoluble alcohol	rhombic
insoluble	insoluble	soluble acids, alkalies	.....
5.4⁰°	93	insoluble alcohol	monoclinic
.....	.....	.....	.....
.....	.....	.....	.....
soluble	v. soluble	insoluble alcohol	rhombohedral
.....	.....	.....	.....
56⁰°	193	.....	.....
soluble	soluble	insoluble alcohol, Na and K salts	.....
soluble	soluble	insoluble alcohol, Na and K salts	amorphous
67.4⁰°	81.3⁹⁵°	insoluble alcohol	hexagonal plates
4.8⁰°	42.5¹⁰⁰°	insoluble alcohol	rhombic monoclinic

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	NAME	FORMULA	MOLECULAR WEIGHT	SPECIFIC GRAVITY WATER, 1 AIR, 1 (A) H_2, 1 (D)	MELTING POINT °C.	BOILING POINT °C.
593	Sodium Sulphide mono-	Na_2S	78.07	2.471	Infusible	
594	Sulphide penta-	Na_2S_5	206.35			
595	Sulphite	Na_2SO_3	126.07		150°	decomp.
596	Sulphite	$Na_2SO_3.7H_2O$	252.18	1.561	$7H_2O$, 150°	decomp.
597	Sulphite acid	$NaHSO_3$	104.08	1.48	decomp.	
598	Stannic acid meta-	$H_{10}Sn_5O_{15}$	845.08			
599	Chloride	$SnCl_4$	260.84	$2.2788^{\frac{0}{4}}$	−33°	114°
600	Oxide	SnO_2	151.00	6.6–6.9	1127°	
601	Oxide cryst	SnO_2	151.00	6.7–6.85	Infusible	
602	Sulphide	SnS_2	183.14	4.42–4.60		
603	Stannous chloride	$SnCl_2$	189.92		249.3°	603°–628
604	Chloride tin salt	$SnCl_2.2H_2O$	225.95	$2.71^{4.5°}$	37.7°	decomp.
605	Hydroxide	$Sn(OH)_2$	153.02			
606	Oxide	SnO	135.00	6.3	decomp.	
607	Sulphate	$SnSO_4$	215.07			
608	Strontium	Sr	87.62	2.54	900°	burns
609	Carbonate	$SrCO_3$	147.62	3.62	dec. 1155°	
610	Chloride	$SrCl_2$	158.54	3.054	872°	
611	Chloride	$SrCl_2.6H_2O$	266.64	$1.964^{18.7°}$	112°	
612	Chromate	$SrCrO_4$	203.72	$3.895^{15°}$		
613	Hydroxide	$Sr(OH)_2$	121.64	3.625		
614	Nitrate	$Sr(NO_3)_2$	211.64	$2.981^{4.3°}$	645°	
615	Oxalate	$SrC_2O_4.H_2O$	193.64		decomp.	
616	Oxide	SrO	103.62	4.45–4.75	3000°	
617	Sulphate	$SrSO_4$	183.69	3.71–3.97		
618	Sulphur amorph soft	S	256.56	$1.9556^{20°}$	120°	444.6°
619	Yellow	S	256.56	2.046		444.6°
620	Colloidal Sδ	S	256.56			444.6°
621	Plastic Sγ	S	256.56	1.92		444.6°
622	Monoclinic Sβ	S	256.56	1.958	119.25°	444.6°
623	Rhombic Sα	S	256.56	2.05–2.07	114.5°	444.6°
624	Chloride tetra-	SCl_4	173.91		−30°	
625	Oxide di-	SO_2	64.07	2.2639 D $1.43368^{0°}$	−76.1	10°
626	Oxide sesqui-	S_2O_3	112.14		decomp.	
627	Oxide α-tri-	SO_3	80.07	2.75 D $1.97^{20°}$	14.8°	46.2°
628	Oxide β-tri-	$(SO_3)_3$	160.14	1.040	50°	
629	Oxide hepta-	S_2O_7	176.14		0°	decomp
630	Sulphuric acid	H_2SO_4	98.09	$1.8342^{\frac{18}{4}}$	10.46°	
631	Tin	Sn	119.00	6.53–6.56	sta. 170°	2200°
632	Tin	Sn	119.00	$7.2984^{15°}$	232°	
633	Tin	Sn	119.00	$5.8466^{15°}$	sta. 20°	
634	Titanic acid	H_2TiO_3	98.12			
635	Titanium	Ti	48.1	3.543	3000°	
636	Tungsten	W	184.00	18.77	2800°	
637	Zinc	Zn	65.37	$7.142^{18°}$	419°	918°
638	Acetate	$Zn(C_2H_3O_2)_2$	183.42	1.84	242°	
639	Chloride	$ZnCl_2$	136.29	$2.913^{\frac{25}{4}}$	365	730°
640	Hydroxide	$Zn(OH)_2$	99.39	3.053	decomp.	
641	Nitrate	$Zn(NO_3)_2.6H_2O$	297.49	$2.065^{13°}$	36.4°	131°
642	Oxalate	$ZnC_2O_4.2H_2O$	189.04	$2.582^{17.5°}$		
643	Oxide	ZnO	81.37	5.78		
644	Oxide per-	ZnO_2	97.37			
645	Phosphate	$Zn_3(PO_4)_2$	386.11	$3.998^{15°}$	red heat	
646	Phosphate pyro-	$Zn_2P_2O_7$	304.74			
647	Sulphate	$ZnSO_4$	161.44	$3.6235^{15°}$	dec. 400°	
648	Sulphate	$ZnSO_4.7H_2O$	287.55	1.964	50°	
649	Sulphate	$ZnSO_4.6H_2O$	269.54	2.07		
650	Sulphide	ZnS	97.44	3.98	1049°	
651	Sulphide (blende)	ZnS	97.44	4.03–4.07	1049°	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS—Con.

	SOLUBILITY IN 100 PARTS			CRYSTALLINE FORM AND COLOR
	Cold water	Hot water	Alcohol, acids, alkalies, etc.	
93	15.4$^{10°}$	59.2$^{90°}$	s. soluble alcohol; insoluble ether	flesh colored amorph.
94	soluble	soluble	s. soluble alcohol	.....
95	14.$^{10°}$	49.$^{540°}$	insoluble alcohol	.....
96	32.83$^{0°}$	196$^{40°}$	insoluble alcohol	monoclinic prism
97	s. soluble	soluble	insoluble alcohol	.....
98	insoluble	insoluble	insoluble acids; sol. KOH	amorphous
99	soluble	decomp.	sol. alcohol, CS_2, oil of turpentine	liquid
00	insoluble	insoluble	soluble concentrated H_2SO_4	amorphous
01	insoluble	insoluble	soluble concentrated H_2SO_4	tetragonal, hexagonal
02	0.00002	insoluble	soluble conc. HCl, alkalies, sul.	yellow hexagonal
03	83.9$^{0°}$	269.8$^{15°}$	sol. alkalies, alcohol, tartaric acid	.....
04	118.7$^{0°}$	.....	sol. alkalies, alcohol, tartaric acid	monoclinic
05	insoluble	decomp.	sol. dil. acids, alkalies, insoluble	yellow amorphous
06	insoluble	.....	soluble acids, NH_4Cl; insol. alkalies	black regular
07	18.9$^{12°}$	18.2$^{100°}$	soluble H_2SO_4	crystals
08	decomp.	decomp.	soluble acids, alcohol	crystalline
09	0.0011$^{12°}$	.....	0.12 H_2CO_3 aqua; soluble acids	rhombic
10	44.2$^{0°}$	101.9$^{100°}$	soluble absolute alcohol	.....
11	106.2$^{0°}$	205.8$^{40°}$	.....	.....
12	0.12$^{15°}$	.....	soluble acetic acid, NH_4 salts	monoclinic prisms
13	0.41$^{6°}$	21.83$^{100°}$	soluble NH_4Cl	.....
14	39.5$^{6°}$	101.1$^{130°}$	0.012 absolute alcohol	regular octahedral
15	0.0051$^{25°}$	5$^{100°}$	soluble HCl	.....
16	decomp.	.....	s. soluble alcohol, insoluble ether	gray white
17	0.0114$^{25°}$	0.0104$^{100°}$	insoluble diluted H_2SO_4, alcohol	rhombic
18	insoluble	insoluble	partly soluble CS_2	pale yellow amorph.
19	insoluble	.....	insoluble CS_2	amorphous
20	soluble	.....	insoluble NaCl	pale yellow
21	insoluble	.....	insoluble CS_2	citron yellow amorph.
22	insoluble	insoluble	soluble CS_2, alcohol, CH_4Cl, C_6H_6	yellow prisms
23	insoluble	insoluble	24, 181.3, CS_2	yellow octahedral
24	decomp.	decomp.	.....	yellow brown liquid
25	7979 cc.$^{0°}$	1560 cc.$^{60°}$	soluble alcohol, H_2SO_4, $H.C_2H_3O_2$	.....
26	decomp.	.....	decomposes by alcohol, ether	blue green crystals
27	decomp.	decomp.	soluble concentrated H_2SO_4	prismatic crystals
28	decomp.	decomp.	.....	silky needles
29	decomp.	decomp.	soluble concentrated H_2SO_4	needles
30	.....	.....	decomposes alcohol	.....
31	insoluble	insoluble	soluble HCl, H_2SO_4, dilute HNO_3, aqua regia, hot KOH	rhombic
32	insoluble	insoluble		white tetragonal
33	.....	.....		gray
34	insoluble	insoluble	insol. alcohol, sol. acids, alkalies	.....
35	insoluble	decomp.	soluble acids	dark gray amorphous
36	insoluble	insoluble	soluble HNO_3 aqua. regia, conc. hot	gray to black
37	insoluble	insoluble	soluble acids, alkalies, $HC_2H_3O_2$	crystalline
38	30$^{25°}$	44.6$^{100°}$	2.8$^{25°}$166$^{19°}$alcohol	monoclinic laminae
39	209$^{0°}$	616$^{100°}$	100$^{12.5}$ alcohol, v. soluble ether	octahedral
40	0.0004$^{18°}$	insoluble	soluble acids, alkalies	rhombic prisms
41	324.5$^{0°}$	.....	v. soluble alcohol	tetragonal
42	0.008$^{15°}$	.....	soluble acids, alkalies	.....
43	0.001	.....	soluble acids, alkalies, NH_4Cl	yel., hexag. or amorph.
44	insoluble	.....	decomposes by acids	.....
45	insoluble	.....	salts	.....
46	insoluble	.....	soluble acids, alkalies, NH_3 aqua.	.....
47	43.02$^{0°}$	95.03$^{100°}$	s. soluble alcohol	.....
48	115.2$^{0°}$	633.59$^{100°}$	s. soluble alcohol	rhombic prisms
49	.....	.....	.....	monoclinic or tetrag.
50	0.00089	insoluble	v. soluble acids; insoluble $HC_2H_3O_2$	.....
51	0.000065	insoluble	soluble acids, NH_3 aqua.	gray crystals

SEPARATION OF THE METALS INTO GROUPS

Outline of the process

Solution containing all the metals: *add HCl.*

Precipitate:	Filtrate: *add* H_2S.			
	Precipitate:		Filtrate: *add* NH_4OH *and* $(NH_4)_2S$.	
AgCl, HgCl, $PbCl_2$.	HgS, PbS, Bi_2S_3, CdS, CuS, As_2S_3, Sb_2S_3, SnS, SnS_2. *Add* $(NH_4)_2Sx$.		Precipitate: AlO_3H_3 CrO_3H_3 CoS, NiS, FeS, ZnS, MnS.	Filtrate: *add* $(NH_4)_2CO_3$.
	Residue: HgS, PbS, Bi_2S_3, CdS, CuS.	Solution: $(NH_4)_3AsS_4$, $(NH_4)_3SbS_4$, $(NH_4)_2SnS_3$.		Precipitate: $BaCO_3$, $SrCO_3$, $CaCO_3$	Filtrate: Mg. K and Na salts.

PRECIPITATION AND SEPARATION OF LEAD, SILVER AND MERCUROUS MERCURY

Outline of the process

Precipitate: AgCl, HgCl, $PbCl_2$ *add hot water*

Residue: AgCl, HgCl. *add* NH_4OH.		Solution: $PbCl_2$	
Residue: NH_2HgCl	Solution: *add* HNO_3	*add* H_2SO_4 to one part	*add* H_2S to another
Hg,	Precipitate: AgCl.	Precipitate: $PbSO_4$	Precipitate: PbS.

SEPARATION OF MERCURY, LEAD, BISMUTH, CADMIUM AND COPPER

Outline of the process

Precipitate: HgS, PbS, Bi_2S_3, CdS, CuS. *Boil with HNO_3.*

Residue: HgS.
Dissolve in HCl and $KClO_3$; add $SnCl_2$.
Precipitate: HgCl

Solution: *add H_2SO_4.*

Precipitate: $PbSO_4$.

Filtrate: *add NH_4OH.*

Precipitate: BiO_3H_3.
Dissolve in HCl, and add to H_2O.
Precipitate: BiOCl.

Filtrate: *add KCN and H_2S*

Precipitate: CdS.

Solution: KCN.CuCN

SEPARATION OF ARSENIC, ANTIMONY AND TIN

Outline of the process

Precipitate: As_2S_3, Sb_2S_3, SnS_2. *Add strong HCl.*

Residue: As_2S_3.
Dissolve in HCl and $KClO_3$; add NH_4OH, NH_4Cl, and $MgCl_2$.
Precipitate: $MgNH_4AsO_4$.

Solution: $SbCl_3$, $SnCl_4$ (and small amount of H_3AsO_4).
Place in hydrogen generator.

Residue: Sn.
Dissolve in strong HCl and add $HgCl_2$.
Precipitate: HgCl.

Gas evolved: SbH_3 (and AsH_3).
Pass through a hot tube.

Deposit: Sb (and As).
Treat with NaOCl.

Residue: Sb.

Solution: (H_3AsO_4).

SEPARATION OF NICKEL AND COBALT

Outline of the process

Precipitate: AlO_3H_3, CrO_3H_3, CoS, NiS, FeS, MnS, ZnS, $[Ba_3(PO_4)_2]$, $Sr_3(PO_4)_2$, $Ca_3(PO_4)_2$, $Mg(NH_4)PO_4$]. *Treat with dilute HCl.*

Residue: CoS, NiS (FeS in small amount). *Dissolve in aqua regia and add NH_4OH.*

Solution.

Precipitate: FeO_3H_3

Filtrate: *expel NH_4 salts, add KNO_2 and $HC_2H_3O_2$.*

Precipitate: $Co(NO_2)_6 \cdot 3KNO_2$.

Solution: *add NaOH.*
Precipitate: NiO_3H_3
Test in borax bead.

SEPARATION OF ALUMINUM, CHROMIUM IRON, MANGANESE, ZINC

Outline of the process

Solution: $AlCl_3$, $CrCl_3$, $FeCl_2$, $MnCl_2$, $ZnCl_2$, $BaCl_2$, $SrCl_2$, $CaCl_2$, $MgCl_2$, H_3PO_4.

Add H_2SO_4 and alcohol to a part.

- Precipitate: $BaSO_4$, $SrSO_4$, $CaSO_4$. *Fuse with Na_2CO_3; add water.*
  - Residue: $BaCO_3$, $SrCO_3$, $CaCO_3$. *Add HNO_3.*
    - Solution: $Ba(NO_3)_2$, $Sr(NO_3)_2$, $Ca(NO_3)_2$
  - Filtrate. *Reject.*

Boil a part with HNO_3 and add $K_4Fe(CN)_6$.

- Precipitate: Ferric ferrocyanide.

Boil the rest with HNO_3, add $FeCl_3$ and $BaCO_3$.

- Precipitate: FeO_3H_3, AlO_3H_3, CrO_3H_3, $FePO_4$ ($BaCO_3$). *Dissolve in HCl and add H_2SO_4.*
  - Precipitate: $BaSO_4$.
  - Filtrate. *Add NaOH and boil.*
    - Precipitate: FeO_3H_3, CrO_3H_3. *Fuse with Na_2CO_3 and $KClO_3$.*
      - Na_2CrO_4 formed.
    - Filtrate: *add HCl and NH_4OH.*
      - Precipitate: AlO_3H_3.

Filtrate. *Add NH_4OH and $(NH_4)_2S$.*

- Precipitate: MnS, ZnS. *Dissolve in HCl and add NaOH.*
  - Precipitate: MnO_2H_2. *Fuse with Na_2CO_3.*
    - Na_2MnO_4 formed.
  - Filtrate. *Add H_2S.*
    - Precipitate: ZnS.
- Filtrate. *Add $(NH_4)_2CO_3$ and $(NH_4)_2C_2O_4$.*
  - Precipitate: $BaCO_3$, $SrCO_3$, $CaCO_3$, CaC_2O_4. *Reject.*
  - Filtrate. *Add Na_2HPO_4.*
    - Precipitate: $MgNH_4PO_4$.

SEPARATION OF BARIUM, STRONTIUM CALCIUM, MAGNESIUM AND ALKALI METALS

Outline of the process

Solution: Ba, Sr, Ca, Mg, K, Na, and NH_4 salts. *Add* $(NH_4)_2CO_3$.

Precipitate: $BaCO_3$, $SrCO_3$, $CaCO_3$. *Dissolve in* HNO_3 *and evaporate the solution to dryness. Treat the residue with alcohol-ether mixture.*

Residue: $Ba(NO_3)_2$, $Sr(NO_3)_2$. *Dissolve in water, and add* K_2CrO_4.

Precipitate: $BaCrO_4$.

Solution: *add* $(NH_4)_2CO_3$.

Precipitate: $SrCO_3$.

Solution: *add dilute* H_2SO_4.

Precipitate: $CaSO_4$

Filtrate. *Add* $(NH_4)_2C_2O_4$ *and* $(NH_4)_2SO_4$.

Precipitate: CaC_2O_4, $BaSO_4$.

Filtrate. *Divide into two parts.*

Add NH_4OH *and* Na_2HPO_4.

Precipitate: $MgNH_4PO_4$.

Expel NH_4 *salts, and dissolve the residue in water.*

Test in flame.

Yellow color, Na.

Add H_2PtCl_6.

Precipitate: K_2PtCl_6.

TEXT BOOKS, MANUALS AND REFERENCE BOOKS

Physics

Adams' "Physical Laboratory Manual."
Ames' "Theory of Physics."
Ames' "Text Book of General Physics"
Ames and Bliss' "Manual of Experiments in Physics."
Avery's "School Physics."
Ayrton's "Practical Electricity."
Bonney's "Induction Coils." (A practical manual for amateur coil makers.)
Bottone's "Electrical Instrument Making."
Bottone's "Galvanic Batteries."
Boys' "Soap Bubbles and Forces Which Mould Them."
Carhart's "Electrical Measurements."
Carhart's "Primary Batteries."
Carhart's "University Physics." Part I, Part II.
Carhart and Chute's "High School Physics."
Carhart and Patterson's "Electrical Measurements."
Chester, Dean and Timmerman's "Laboratory Manual in Physics."
Chute's "Practical Physics."
Chute's "Laboratory Manual."
Coleman's "Laboratory Manual."
Cooley's "Student's Manual of Physics."
Crew's "Elements of Physics."
Crew's "General Physics."
Crew and Tatnall's "Laboratory Manual of Physics."
Cajori's "History of Physics in Its Elementary Branches."
Dolbear's "First Principles of Natural Philosophy."
Dolbear's "Art of Projection."
Derr's "Potography for Students of Physics and Chemistry."
Everett's "C. G. S. System of Units."
Ferry's "Brief Course in Elementary Dynamics."
Ferry's "Practical Physics."
Gage's "Principles of Physics." (Revised by Goodspeed.)
Gage's "Laboratory Manual and Note Book."
Ganot's "Elements of Physics." (Seventeenth edition.)
Hall and Bergen's "Text Book of Physics."
Harvard "Descriptive List of Elementary Physics Experiments.
Hasting and Beach's "Text Book of General Physics."
Hoadley's "Brief Course in Physics."
Hopkins' "Experimental Science." (Twenty-third edition.) Two volumes.
Jackson's "Elementary Electricity and Magnetism."
Kerr's "Wireless Telegraphy."
Lockyer's "Spectrum Analysis."
Lodge's "Elementary Mechanics."
Mann's "Manual of Advanced Optics."
Mann and Twiss' "Physics."
Meadowcoft's "A, B, C of Electricity."
Miller's "Laboratory Physics."
Millikan's "Mechanics, Molecular Physics and Heat."

Millikan and Gale's "A First Course in Physics."
Millikan and Gale's "A Laboratory Course in Physics."
Millikan and Mill's "Electricity, Sound and Light."
Mumper's "Text Book of Physics."
Michelson's "The Velocity of Light."
Michelson's "Light Waves and Their Uses."
Nichols' "Outlines of Physics."
Nichols' "Laboratory Manual of Applied Electricity and Magnetism." Vol. I, Vol. II.
Nichols' Smith and Turton's "Manual of Experimental Physics."
Ostwald's "Manual of Physical and Chemical Measurements."
Rood's "Modern Chromatics."
Roscoe's "Spectrum Analysis."
Salomon's "Experiments with Vacuum Tubes."
Sabine's "Laboratory Course in Physical Measurements."
Shearer's "Notes and Questions in Physics."
Smithsonian "Instrument Tables."
Stewart and Gee's "Lessons in Elementary Practical Physics."
Stewart's "Lessons in Elementary Physics."
Twiss' "Laboratory Lessons in Physics."
Thompson's "Elementary Lessons in Electricity and Magnetism."
Thompson's "Dynamo and Electric Machinery."
Thompson's "Light Visible and Invisible."
Trevert's "A, B, C of Wireless Telegraphy."
Tyndall's "Heat."
Tyndall's "Sound."
Watson's "Text Book of Physics."
Watson's "Text Book of Practical Physics."
Wentworth and Hill's "Text Book of Physics."
Wentworth and Hills' "Laboratory Exercises in Physics."
Whiting's "Physical Measurements."
Whiting's "Mathematical and Physical Tables."

Chemistry

Arrhenius' "Immuno-Chemistry."
Baskerville's "General Inorganic Chemistry."
Baskerville and Curtis' "Laboratory Manual."
Brownlee and Others "Principles of Chemistry."
Brownlee and Others "Laboratory Manual."
Chicago High School Manual of Chemistry."
Clarke and Dennis' "Elementary Chemistry."
Clarke and Dennis' "Laboratory Manual."
Blount's "Practical Electro-Chemistry."
Cohen's "Tests and Reagents."
Fresenius' "Quantitative Chemical Analysis." Two volumes.
Getman's "Blow Pipe Analysis."
Hempel's "Methods of Gas Analysis."
Hessler & Smith's "Essentials of Chemistry with Manual."
Irish's "Qualitative Analysis for Secondary Schools."
Jones' "Elements of Physical Chemistry."
Jones' "Electrolytic Dissociation."

Jones' "Elements of Inorganic Chemistry."
Le Blanc's "Text Book of Electro-Chemistry."
Linebarger's "Elementary Chemistry."
McGregory's "Manual of Qualitative Chemical Analysis."
McPherson and Henderson's "An Elementary Study in Chemistry."
McPherson and Henderson's "Exercises in Chemistry."
Nernst's "Theoretical Chemistry from Standpoint of Avagadro's Rule and Thermo-Dynamics."
Newell's "Descriptive Chemistry."
Newell's "Experimental Chemistry."
Newell's "Manual of Experiments."
Noyes' "Qualitative Chemical Analysis."
Noyes' "Elements of Qualitative Chemical Analysis."
Noyes' "Organic Chemistry."
Ostwald's "Manual of Physical and Chemical Measurements."
Ostwald's "Principles of Inorganic Chemistry."
Rolfe's "The Polariscope in the Chemical Laboratory."
Smith and Hale's "Laboratory Outline in General Chemistry."
Stoddard's "Outline of Qualitative Analysis."
Storer and Lindsay's "Elementary Manual of Chemistry."
Remsen's "Organic Chemistry."
Remsen's "Inorganic Chemistry."
Remsen's "College Text Book in Chemistry."
Remsen's "Introduction to Study of Chemistry."
Remsen's "Laboratory Manual."
Talbot & Blanchard's "Electrolytic Dissociation Theory."
Walker's "Introduction to Physical Chemistry."
Williams' "Elements of Chemistry."
Williams' "Introduction to Chemical Science."
Williams' "Chemical Experiments."
Williams' "Laboratory Manual in Inorganic Chemistry."
Williams' "Laboratory Manual in General Chemistry."
Young's "Fractional Distillation."

SULPHURIC ACID

Lunge and Isler

SPECIFIC GRAVITY 15° / 4° IN VACUO	100 PARTS BY WEIGHT CORRESPOND TO		1 LITER CONTAINS GRAMS		SPECIFIC GRAVITY 15° / 4° IN VACUO	100 PARTS BY WEIGHT CORRESPOND TO		1 LITER CONTAINS GRAMS	
	SO_3	H_2SO_4	SO_3	H_2SO_4		SO_3	H_2SO_4	SO_3	H_2SO_4
	per cent	per cent				per cent	per cent		
1.000	0.07	0.09	1	1	1.265	28.69	35.14	363	444
1.005	0.68	0.83	7	8	1.270	29.15	35.71	370	454
1.010	1.28	1.57	13	16	1.275	29.62	36.29	377	462
1.015	1.88	2.30	19	23	1.280	30.10	36.87	385	472
1.020	2.47	3.03	25	31	1.285	30.57	37.45	393	481
1.025	3.07	3.76	32	39	1.290	31.04	38.03	400	490
1.030	3.67	4.49	38	46	1.295	31.52	38.61	408	500
1.035	4.27	5.23	44	54	1.300	31.99	39.19	416	510
1.040	4.87	5.96	51	62	1.305	32.46	39.77	424	519
1.045	5.45	6.67	57	71	1.310	32.94	40.35	432	529
1.050	6.02	7.37	63	77	1.315	33.41	40.93	439	538
1.055	6.59	8.07	70	85	1.320	33.88	41.50	447	548
1.060	7.16	8.77	76	93	1.325	34.35	42.08	455	557
1.065	7.73	9.47	82	102	1.330	34.80	42.66	462	567
1.070	8.32	10.19	89	109	1.335	35.27	43.20	471	577
1.075	8.90	10.90	96	117	1.340	35.71	43.74	479	586
1.080	9.47	11.60	103	125	1.345	36.14	44.28	486	596
1.085	10.04	12.30	109	133	1.350	36.58	44.82	494	605
1.090	10.60	12.99	116	142	1.355	37.02	45.35	502	614
1.095	11.16	13.67	122	150	1.360	37.45	45.88	509	624
1.100	11.71	14.35	129	158	1.365	37.89	46.41	517	633
1.105	12.27	15.03	136	166	1.370	38.32	46.94	525	643
1.110	12.82	15.71	143	175	1.375	38.75	47.47	533	653
1.115	13.36	16.36	149	183	1.380	39.18	48.00	541	662
1.120	13.89	17.01	156	191	1.385	39.62	48.53	549	672
1.125	14.42	17.66	162	199	1.390	40.05	49.06	557	682
1.130	14.95	18.31	169	207	1.395	40.48	49.59	564	692
1.135	15.48	18.96	176	215	1.400	40.91	50.11	573	702
1.140	16.01	19.61	183	223	1.405	41.33	50.63	581	711
1.145	16.54	20.26	189	231	1.410	41.76	51.15	589	721
1.150	17.07	20.91	196	239	1.415	42.17	51.66	597	730
1.155	17.59	21.55	203	248	1.420	42.57	52.15	604	740
1.160	18.11	22.19	210	257	1.425	42.96	52.63	612	750
1.165	18.64	22.83	217	266	1.430	43.36	53.11	620	759
1.170	19.16	23.47	224	275	1.435	43.75	53.59	628	769
1.175	19.69	24.12	231	283	1.440	44.14	54.07	636	779
1.180	20.21	24.76	238	292	1.445	44.53	54.55	643	789
1.185	20.73	25.40	246	301	1.450	44.92	55.03	651	798
1.190	21.26	26.04	253	310	1.455	45.31	55.50	659	808
1.195	21.78	26.68	260	319	1.460	45.69	55.97	667	817
1.200	22.30	27.32	268	328	1.465	46.07	56.43	675	827
1.205	22.82	27.95	275	337	1.470	46.45	56.90	683	837
1.210	23.33	28.58	282	346	1.475	46.83	57.37	691	846
1.215	23.84	29.21	290	355	1.480	47.21	57.83	699	856
1.220	24.36	29.84	297	364	1.485	47.57	58.28	707	865
1.225	24.88	30.48	305	373	1.490	47.95	58.74	715	876
1.230	25.39	31.11	312	382	1.495	48.34	59.22	723	885
1.235	25.88	31.70	320	391	1.500	48.73	59.70	731	896
1.240	26.35	32.28	327	400	1.505	49.12	60.18	739	906
1.245	26.83	32.86	334	409	1.510	49.51	60.65	748	916
1.250	27.29	33.43	341	418	1.515	49.89	61.12	756	926
1.255	27.76	34.00	348	426	1.520	50.28	61.59	764	936
1.260	28.22	34.57	356	435	1.525	50.66	62.06	773	946

SULPHURIC ACID—Continued

Lunge and Isler

SPECIFIC GRAVITY 15° IN VACUO 4°	100 PARTS BY WEIGHT CORRESPOND TO		1 LITER CONTAINS GRAMS		SPECIFIC GRAVITY 15° IN VACUO 4°	100 PARTS BY WEIGHT CORRESPOND TO		1 LITER CONTAINS GRAMS	
	SO_3	H_2SO_4	SO_3	H_2SO_4		SO_3	H_2SO_4	SO_3	H_2SO_4
	per cent	*per cent*				*per cent*	*per cent*		
1.530	51.04	62.53	781	957	1.750	66.58	81.56	1165	1427
1.535	51.43	63.00	789	967	1.755	66.94	82.00	1175	1439
1.540	51.78	63.43	797	977	1.760	67.30	82.44	1185	1451
1.545	52.12	63.85	805	987	1.765	67.65	82.88	1194	1463
1.550	52.46	64.26	813	996	1.770	68.02	83.32	1204	1475
1.555	52.79	64.67	821	1006	1.775	68.49	83.90	1216	1489
1.560	53.12	65.08	829	1015	1.780	68.98	84.50	1228	1504
1.565	53.46	65.49	837	1025	1.785	69.47	85.10	1240	1519
1.570	53.80	65.90	845	1035	1.790	69.96	85.70	1252	1534
1.575	54.13	66.30	853	1044	1.795	70.46	86.30	1265	1549
1.580	54.46	66.71	861	1054	1.800	70.94	86.90	1277	1564
1.585	54.80	67.13	869	1064	1.805	71.50	87.60	1291	1581
1.590	55.18	67.59	877	1075	1.810	72.08	88.30	1305	1598
1.595	55.55	68.05	886	1085	1.815	72.69	89.05	1319	1621
1.600	55.93	68.51	894	1096	1.820	73.51	90.05	1338	1639
1.605	56.30	68.97	904	1107	1.821	73.63	90.20	1341	1643
1.610	56.68	69.43	913	1118	1.822	73.80	90.40	1345	1647
1.615	57.05	69.89	921	1128	1.823	73.96	90.60	1348	1651
1.620	57.40	70.32	930	1139	1.824	74.12	90.80	1352	1656
1.625	57.75	70.74	938	1150	1.825	74.29	91.00	1356	1661
1.630	58.09	71.16	947	1160	1.826	74.49	91.25	1360	1666
1.635	58.43	71.57	955	1170	1.827	74.69	91.50	1364	1671
1.640	58.77	71.99	964	1181	1.828	74.86	91.70	1368	1676
1.645	59.10	72.40	972	1192	1.829	75.03	91.90	1372	1681
1.650	59.45	72.82	981	1202	1.830	75.19	92.10	1376	1685
1.655	59.78	73.23	989	1212	1.831	75.35	92.30	1380	1690
1.660	60.11	73.64	998	1222	1.832	75.53	92.52	1384	1695
1.665	60.46	74.07	1007	1233	1.833	75.72	92.75	1388	1700
1.670	60.82	74.51	1016	1244	1.834	75.96	93.05	1393	1706
1.675	61.20	74.97	1025	1256	1.835	76.27	93.43	1400	1713
1.680	61.57	75.42	1034	1267	1.836	76.57	93.80	1405	1722
1.685	61.93	75.86	1043	1278	1.837	76.90	94.20	1412	1730
1.690	62.29	76.30	1053	1289	1.838	77.23	94.60	1419	1739
1.695	62.64	76.73	1062	1301	1.839	77.55	95.00	1426	1748
1.700	63.00	77.17	1071	1312	1.840	78.04	95.60	1436	1759
1.705	63.35	77.60	1080	1323	1.8405	78.33	95.95	1441	1765
1.710	63.70	78.04	1089	1334	1.8410	79.19	97.00	1458	1786
1.715	64.07	78.48	1099	1346	1.8415	79.76	97.70	1469	1799
1.720	64.43	78.92	1108	1357	1.8410	80.16	98.20	1476	1808
1.725	64.78	79.36	1118	1369	1.8405	80.57	98.70	1483	1816
1.730	65.14	79.80	1127	1381	1.8400	80.98	99.20	1490	1825
1.735	65.50	80.24	1136	1392	1.8395	81.18	99.45	1494	1830
1.740	65.86	80.68	1146	1404	1.8390	81.39	99.70	1497	1834
1.745	66.22	81.12	1156	1416	1.8385	81.59	99.95	1500	1838

NITRIC ACID

By W. C. Ferguson

DEGREES BAUMÉ	SPECIFIC GRAVITY $\frac{60°}{60°}$ F.	DEGREES TWADDELL	PER CENT HNO_3	DEGREES BAUMÉ	SPECIFIC GRAVITY $\frac{60°}{60°}$ F.	DEGREES TWADDELL	PER CENT HNO_3
10.00	1.0741	14.82	12.86	23.75	1.1959	39.18	31.58
10.25	1.0761	15.22	13.18	24.00	1.1983	39.66	31.94
10 50	1.0781	15.62	13.49	24.25	1.2008	40.16	32.31
10.75	1.0801	16.02	13.81	24.50	1.2033	40.66	32.68
11.00	1.0821	16.42	14.13	24.75	1.2058	41.16	33 05
11.25	1.0841	16.82	14.44	25.00	1.2083	41.66	33.42
11.50	1.0861	17.22	14.76	25.25	1.2109	42.18	33 80
11.75	1.0881	17.62	15.07	25.50	1.2134	42.68	34 17
12.00	1.0902	18.04	15.41	25.75	1.2160	43.20	34.56
12.25	1.0922	18.44	15.72	26.00	1.2185	43.70	34.94
12.50	1.0943	18.86	16.05	26.25	1.2211	44.22	35.33
12.75	1.0964	19.28	16.39	26.50	1.2236	44.72	35.70
13.00	1.0985	19.70	16.72	26.75	1.2262	45.24	36 09
13.25	1.1006	20.12	17.05	27.00	1.2288	45.76	36.48
13.50	1.1027	20.54	17.38	27.25	1.2314	46.28	36.87
13.75	1.1048	20.96	17.71	27.50	1.2340	46.80	37.26
14.00	1.1069	21.38	18.04	27.75	1.2367	47.34	37.67
14.25	1.1090	21.80	18.37	28.00	1.2393	47.86	38.06
14.50	1.1111	22.22	18.70	28.25	1.2420	48.40	38.46
14.75	1.1132	22.64	19.02	28.50	1.2446	48.92	38.85
15.00	1.1154	23.08	19.36	28.75	1.2473	49.46	39.25
15.25	1.1176	23.52	19.70	29.00	1.2500	50.00	39.66
15.50	1.1197	23.94	20.02	29.25	1.2527	50.54	40.06
15.75	1.1219	24.38	20.36	29.50	1.2554	51.08	40.47
16.00	1.1240	24.80	20.69	29.75	1.2582	51.64	40.89
16.25	1.1262	25.24	21.03	30.00	1.2609	52.18	41.30
16.50	1.1284	25.68	21.36	30.25	1.2637	52.74	41.72
16.75	1.1306	26.12	21.70	30.50	1.2664	53.28	42.14
17.00	1.1328	26.56	22.04	30.75	1.2692	53.84	42.58
17.25	1.1350	27.00	22.38	31.00	1.2719	54.38	43.00
17.50	1.1373	27.46	22.74	31.25	1.2747	54.94	43.44
17.75	1.1395	27.90	23.08	31.50	1.2775	55.50	43.89
18.00	1.1417	28.34	23.42	31.75	1.2804	56.08	44.34
18.25	1.1440	28.80	23.77	32.00	1.2832	56.64	44.78
18.50	1.1462	29.24	24.11	32.25	1.2861	57.22	45.24
18.75	1.1485	29.70	24.47	32.50	1.2889	57.78	45.68
19.00	1.1508	30.16	24.82	32.75	1.2918	58.36	46.14
19.25	1.1531	30.62	25.18	33.00	1.2946	58.92	46.58
19.50	1.1554	31.08	25.53	33.25	1.2975	59.50	47.04
19.75	1.1577	31.54	25.88	33.50	1.3004	60 08	47.49
20.00	1.1600	32.00	26.24	33.75	1.3034	60.68	47.95
20.25	1.1624	32.48	26.61	34.00	1.3063	61.26	48 42
20.50	1.1647	32.94	26.96	34.25	1.3093	61.86	48.90
20.75	1.1671	33.42	27.33	34.50	1.3122	62.44	49.35
21.00	1.1694	33.88	27.67	34.75	1.3152	63.04	49.83
21.25	1.1718	34.36	28 02	35.00	1.3182	63.64	50.32
21.50	1.1741	34.82	28.36	35.25	1.3212	64.24	50.81
21.75	1.1765	35 30	28.72	35.50	1.3242	64.84	51.30
22.00	1.1789	35.78	29.07	35.75	1.3273	65.46	51.80
22.25	1.1813	36.26	29.43	36.00	1.3303	66.06	52.30
22.50	1.1837	36.74	29.78	36.25	1 3334	66.68	52.81
22.75	1.1861	37.22	30.14	36.50	1.3364	67.28	53.32
23.00	1.1885	37.70	30.49	36.75	1.3395	67.90	53.84
23.25	1.1910	38.20	30.86	37.00	1.3426	68.52	54.36
23.50	1.1934	38.68	31.21	37.25	1.3457	69.14	54.89

NITRIC ACID—Continued

DEGREES BAUMÉ	SPECIFIC GRAVITY 60° F. 60° F.	DEGREES TWADDELL	PER CENT HNO_3	DEGREES BAUMÉ	SPECIFIC GRAVITY 60° F. 60° F.	DEGREES TWADDELL	PER CENT HNO_3
37.50	1.3488	69.76	55.43	43.25	1.4251	85.02	71.1[illegible]
37.75	1.3520	70.40	55.97	43.50	1.4286	85.72	71.9[illegible]
38.00	1.3551	71.02	56.52	43.75	1.4321	86.42	72.82
38.25	1.3583	71.66	57.08	44.00	1.4356	87.12	73.67
38.50	1.3615	72.30	57.65	44.25	1.4392	87.84	74.53
38.75	1.3647	72.94	58.23	44.50	1.4428	88.56	75.40
39.00	1.3679	73.58	58.82	44.75	1.4464	89.28	76.28
39.25	1.3712	74.24	59.43	45.00	1.4500	90.00	77.17
39.50	1.3744	74.88	60.06	45.25	1.4536	90.72	78.07
39.75	1.3777	75.54	60.71	45.50	1.4573	91.46	79.03
40.00	1.3810	76.20	61.38	45.75	1.4610	92.20	80.04
40.25	1.3843	76.86	62.07	46.00	1.4646	92.92	81.08
40.50	1.3876	77.52	62.77	46.25	1.4684	93.68	82.18
40.75	1.3909	78.18	63.48	46.50	1.4721	94.42	83.33
41.00	1.3942	78.84	64.20	46.75	1.4758	95.16	84.48
41.25	1.3976	79.52	64.93	47.00	1.4796	95.92	85.70
41.50	1.4010	80.20	65.67	47.25	1.4834	96.68	86.98
41.75	1.4044	80.88	66.42	47.50	1.4872	97.44	88.32
42.00	1.4078	81.56	67.18	47.75	1.4910	98.20	89.76
42.25	1.4112	82.24	67.95	48.00	1.4948	98.96	91.35
42.50	1.4146	82.92	68.73	48.25	1.4987	99.74	93.13
42.75	1.4181	83.62	69.52	48.50	1.5026	100.52	95.11
43.00	1.4216	84.32	70.33				

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for temperature:

At 10° – 20° Bé. – 1/30° Bé. or 0.00029 Sp. Gr. = 1° F.
20° – 30° Bé. – 1/23° Bé. or 0.00044 Sp. Gr. = 1° F.
30° – 40° Bé. – 1/20° Bé. or 0.00060 Sp. Gr. = 1° F.
40° – 48.5° Bé. – 1/17° Be. or 0.00084 Sp. Gr. = 1° F.

Authority—W. C. Ferguson

HYDROCHLORIC ACID

By W. C. Ferguson

DEGREES BAUMÉ	SPECIFIC GRAVITY	DEGREES TWADDELL	PER CENT HCl	DEGREES BAUMÉ	SPECIFIC GRAVITY	DEGREES TWADDELL	PER CENT HCl
1.00	1.0069	1.38	1.40	16.7	1.1301	26.02	25.72
2.00	1.0140	2.80	2 82	16.8	1.1310	26.20	25.89
3.00	1.0211	4.22	4.25	16.9	1.1319	26.38	26.05
4.00	1.0284	5.68	5 69	17.0	1.1328	26.56	26.22
5.00	1.0357	7.14	7.15	17.1	1.1336	26.72	26.39
5.25	1.0375	7.50	7.52	17.2	1.1345	26.90	26.56
5.50	1.0394	7.88	7 89	17.3	1.1354	27.08	26.73
5.75	1.0413	8.26	8.26	17.4	1.1363	27.26	26.90
6.00	1.0432	8.64	8.64	17.5	1.1372	27.44	27.07
6.25	1.0450	9.00	9 02	17.6	1.1381	27.62	27.24
6.50	1.0469	9.38	9 40	17.7	1.1390	27.80	27.41
6.75	1.0488	9.76	9.78	17.8	1.1399	27.98	27.58
7.00	1.0507	10.14	10.17	17.9	1.1408	28.16	27.75
7.25	1.0526	10.52	10.55	18.0	1.1417	28.34	27.92
7.50	1.0545	10.90	10.94	18.1	1.1426	28.52	28.09
7.75	1.0564	11.28	11.32	18.2	1.1435	28.70	28.26
8.00	1.0584	11.68	11.71	18.3	1.1444	28.88	28.44
8.25	1.0603	12.06	12.09	18.4	1.1453	29.06	28.61
8.50	1.0623	12.46	12.48	18.5	1.1462	29.24	28.78
8.75	1.0642	12.84	12.87	18.6	1.1471	29.42	28.95
9.00	1.0662	13.24	13.26	18.7	1.1480	29.60	29.13
9.25	1.0681	13.62	13.65	18.8	1.1489	29.78	29.30
9.50	1.0701	14.02	14.04	18.9	1.1498	29.96	29.48
9.75	1.0721	14.42	14.43	19.0	1.1508	30.16	29.65
10.00	1.0741	14.82	14.83	19.1	1.1517	30.34	29.83
10.25	1.0761	15.22	15.22	19.2	1.1526	30.52	30.00
10.50	1.0781	15.62	15.62	19.3	1.1535	30.70	30.18
10.75	1.0801	16.02	16.01	19.4	1.1544	30.88	30.35
11.00	1.0821	16.42	16.41	19.5	1.1554	31.08	30.53
11.25	1.0841	16.82	16.81	19.6	1.1563	31.26	30.71
11.50	1.0861	17.22	17.21	19.7	1.1572	31.44	30.90
11.75	1.0881	17.62	17.61	19.8	1.1581	31.62	31.08
12.00	1.0902	18.04	18.01	19.9	1.1590	31.80	31.27
12.25	1.0922	18.44	18.41	20.0	1.1600	32.00	31.45
12.50	1.0943	18.86	18.82	20.1	1.1609	32.18	31.64
12.75	1.0964	19.28	19.22	20.2	1.1619	32.38	31.82
13.00	1.0985	19.70	19.63	20.3	1.1628	32.56	32.01
13.25	1.1006	20.12	20.04	20.4	1.1637	32.74	32.19
13.50	1.1027	20.54	20.45	20.5	1.1647	32.94	32.38
13.75	1.1048	20.96	20.86	20.6	1.1656	33.12	32.56
14.00	1.1069	21.38	21.27	20.7	1.1666	33.32	32.75
14.25	1.1090	21.80	21.68	20.8	1.1675	33.50	32.93
14.50	1.1111	22.22	22.09	20.9	1.1684	33.68	33.12
14.75	1.1132	22.64	22.50	21.0	1.1694	33.88	33.31
15.00	1.1154	23.08	22.92	21.1	1.1703	34.06	33.50
15.25	1.1176	23.52	23.33	21.2	1.1713	34.26	33.69
15.50	1.1197	23.94	23.75	21.3	1.1722	34.44	33.88
15.75	1.1219	24.38	24.16	21.4	1.1732	34.64	34.07
16.0	1.1240	24.80	24.57	21.5	1.1741	34.82	34.26
16.1	1.1248	24.96	24.73	21.6	1.1751	35.02	34.45
16.2	1.1256	25.12	24.90	21.7	1.1760	35.20	34.64
16.3	1.1265	25.30	25.06	21.8	1.1770	35.40	34.83
16.4	1.1274	25.48	25.23	21.9	1.1779	35.58	35.02
16.5	1.1283	25.66	25.39	22.0	1.1789	35.78	35.21
16.6	1.1292	25.84	25.56	22.1	1.1798	35.96	35.40

HYDROCHLORIC ACID—Continued

DEGREES BAUMÉ	SPECIFIC GRAVITY	DEGREES TWADDELL	PER CENT HCl	DEGREES BAUMÉ	SPECIFIC GRAVITY	DEGREES TWADDELL	PER CENT HCl
22.2	1.1808	36.16	35.59	23.9	1.1973	39.46	39.18
22.3	1.1817	36.34	35.78	24.0	1.1983	39.66	39.41
22.4	1.1827	36.54	35.97	24.1	1.1993	39.86	39.64
22.5	1.1836	36.72	36.16	24.2	1.2003	40.06	39.86
22.6	1.1846	36.92	36.35	24.3	1.2013	40.26	40.09
22.7	1.1856	37.12	36.54	24.4	1.2023	40.46	40.32
22.8	1.1866	37.32	36.73	24.5	1.2033	40.66	40.55
22.9	1.1875	37.50	36.93	24.6	1.2043	40.86	40.78
23.0	1.1885	37.70	37.14	24.7	1.2053	41.06	41.01
23.1	1.1895	37.90	37.36	24.8	1.2063	41.26	41.24
23.2	1.1904	38.08	37.58	24.9	1.2073	41.46	41.48
23.3	1.1914	38.28	37.80	25.0	1.2083	41.66	41.72
23.4	1.1924	38.48	38.03	25.1	1.2093	41.86	41.99
23.5	1.1934	38.68	38.26	25.2	1.2103	42.06	42.30
23.6	1.1944	38.88	38.49	25.3	1.2114	42.28	42.64
23.7	1.1953	39.06	38.72	25.4	1.2124	42.48	43.01
23.8	1.1963	39.26	38.95	25.5	1.2134	42.68	43.40

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}$$

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for temperature:

10 — 15° Bé. — 1/40° Bé. or 0.0002 Sp. Gr. for 1° F.
15 — 22° Bé. — 1/30° Bé. or 0.0003 Sp. Gr. for 1° F.
22 — 25° Bé. — 1/28° Bé. or 0.00035 Sp. Gr. for 1° F.

AQUA AMMONIA

According to W. C. Ferguson

DEGREES BAUMÉ	SPECIFIC GRAVITY 60° / 60° F.	PER CENT NH_3	DEGREES BAUMÉ	SPECIFIC GRAVITY 60° / 60° F.	PER CENT NH_3
10.00	1.0000	0.00	19.75	0.9349	17.28
10.25	0.9982	0.40	20.00	0.9333	17.70
10.50	0.9964	0.80	20.25	0.9318	18.24
10.75	0.9947	1.21	20.50	0.9302	18.72
11.00	0.9929	1.62	20.75	0.9287	19.20
11.25	0.9912	2.04	21.00	0.9272	19.68
11.50	0.9894	2.46	21.25	0.9256	20.16
11.75	0.9876	2.88	21.50	0.9241	20.64
12.00	0.9859	3.30	21.75	0.9226	21.12
12.25	0.9842	3.73	22.00	0.9211	21.60
12.50	0.9825	4.16	22.25	0.9195	22.08
12.75	0.9807	4.59	22.50	0.9180	22.56
13.00	0.9790	5.02	22.75	0.9165	23.04
13.25	0.9773	5.45	23.00	0.9150	23.52
13.50	0.9756	5.88	23.25	0.9135	24.01
13.75	0.9739	6.31	23.50	0.9121	24.50
14.00	0.9722	6.74	23.75	0.9106	24.99
14.25	0.9705	7.17	24.00	0.9091	25.48
14.50	0.9689	7.61	24.25	0.9076	25.97
14.75	0.9672	8.05	24.50	0.9061	26.46
15.00	0.9655	8.49	24.75	0.9047	26.95
15.25	0.9639	8.93	25.00	0.9032	27.44
15.50	0.9622	9.38	25.25	0.9018	27.93
15.75	0.9605	9.83	25.50	0.9003	28.42
16.00	0.9589	10.28	25.75	0.8989	28.91
16.25	0.9573	10.73	26.00	0.8974	29.40
16.50	0.9556	11.18	26.25	0.8960	29.89
16.75	0.9540	11.64	26.50	0.8946	30.38
17.00	0.9524	12.10	26.75	0.8931	30.87
17.25	0.9508	12.56	27.00	0.8917	31.36
17.50	0.9492	13.02	27.25	0.8903	31.85
17.75	0.9475	13.49	27.50	0.8889	32.34
18.00	0.9459	13.96	27.75	0.8875	32.83
18.25	0.9444	14.43	28.00	0.8861	33.32
18.50	0.9428	14.90	28.25	0.8847	33.81
18.75	0.9412	15.37	28.50	0.8833	34.30
19.00	0.9396	15.84	28.75	0.8819	34.79
19.25	0.9380	16.32	29.00	0.8805	35.28
19.50	0.9365	16.80			

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = \frac{140}{\text{Sp. Gr.}} - 130.$$

ALCOHOL BY VOLUME

Squibb

PER CENT ALCOHOL BY VOLUME	SPECIFIC GRAVITY AT 15.56° 15.56° C.	PER CENT ALCOHOL BY VOLUME	SPECIFIC GRAVITY AT 15.56° 15.56°C.	PER CENT ALCOHOL BY VOLUME	SPECIFIC GRAVITY AT 15.56° 15.56°C.	PER CENT ALCOHOL BY VOLUME	SPECIFIC GRAVITY AT 15.56° 15.56° C.
1	0.9985	26	0.9698	51	0.9323	76	0.8745
2	.9970	27	.9691	52	.9303	77	.8721
3	.9956	28	.9678	53	.9283	78	.8696
4	.9942	29	.9665	54	.9262	79	.8664
5	.9930	30	.9652	55	.9242	80	.8639
6	.9914	31	.9643	56	.9221	81	.8611
7	.9898	32	.9631	57	.9200	82	.8581
8	.9890	33	.9618	58	.9178	83	.8557
9	.9878	34	.9609	59	.9160	84	.8526
10	.9869	35	.9593	60	.9135	85	.8496
11	.9855	36	.9578	61	.9113	86	.8466
12	.9841	37	.9565	62	.9090	87	.8434
13	.9828	38	.9550	63	.9069	88	.8408
14	.9821	39	.9535	64	.9047	89	.8373
15	.9815	40	.9519	65	.9025	90	.8340
16	.9802	41	.9503	66	.9001	91	.8305
17	.9789	42	.9490	67	.8973	92	.8272
18	.9778	43	.9470	68	.8949	93	.8237
19	.9766	44	.9452	69	.8925	94	.8199
20	.9760	45	.9434	70	.8900	95	.8164
21	.9753	46	.9416	71	.8875	96	.8125
22	.9741	47	.9396	72	.8850	97	.8084
23	.9728	48	.9381	73	.8825	98	.8041
24	.9716	49	.9362	74	.8799	99	.7995
25	.9709	50	.9343	75	.8769	100	.7946

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